PERFORMANCE OF WHEAT AS A RELAY CROP WITH TRANSPLANTED AMAN RICE AT DIFFERENT DATES OF SOWING AND CONTROL OF LEAF BLOTCH ORGANISM *BIPOLARIS SOROKINIANA* BY BIOCIDES

A THESIS

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TO MY

LATE FATHER AND BROTHER

THESIS ABSTRACT

PERFORMANCE OF WHEAT AS A RELAY CROP WITH TRANSPLANTED AMAN RICE AT DIFFERENT DATES OF SOWING AND CONTROL OF LEAF BLOTCH ORGANISM *BIPOLARIS SOROKINIANA* BY BIOCIDES

The experiment was conducted at the experimental field of Agrotechnology Discipline of Khulna University during Rabi Season, 2005 to study the appropriate time of sowing for wheat in relay cropping system with Transplanted Aman (T. aman) rice and also the performance of wheat as a relay crop in Khulna region. The experiment was laid out in Randomized Complete Block Design (RCBD). There were five different dates of sowing (22 November, 30 November, 8 December, 16 December and 24 December, 2005) as treatment with three replications. The data of plant height (cm), panicle length (cm), number of grain panicle^{-1}, thousand grain weight (g), grain yields (t ha^{-1}), biological yield (t ha^{-1}) and harvest index (%) were collected. The different dates of sowing had significant effect on plant height (cm), panicle length (cm), number of grain panicle^{-1}, thousand grain weight (g), grain yield (t ha^{-1}) biological yield (t ha^{-1}) and harvest index (%). The longest plant height, panicle length, the highest number of grain per panicle, grain yield (t ha^{-1}), and biological yield (t ha^{-1}) were found in 22nd November sowing. But the harvest index (%) was highest in 24th December sowing and 1000-grain weight (g) was highest in 30th December sowing. The lowest plant height (cm), number of grain per panicle, grain yield (t ha^{-1}) and biological yield (t ha^{-1}) were found in 24th December sowing. But the harvest index (%) was lowest in 30th December sowing and panicle length was lowest in 8th December sowing.

Depending on the first experiment another experiment was conducted in the Plant protection Laboratory at Agrotechnology Discipline of Khulna University to evaluate the effect of different plants extracts namely rhizome of ginger, rhizome of turmeric, garlic bulb, neem leaf, nishindha leaf, datura leaf, marigold leaf,

tobacco leaf, banyan leaf and cows urine at different concentrations (20%, 30%, 40%, 50%, 60%, and 70%) on the mycelia growth and formation of spore of *Bipolaris sorokiniana*, causal agent of leaf blotch disease of wheat. The experiment was conducted in Completely Randomized Design (CRD) with five replications. Mycelial growth and formation of spore of *B. sorokiniana* were recorded. Mycelial growth inhibition percentage was calculated thereafter. In all the cases, the mycelial growth inhibition percentage was found to be increased with the increase of concentration of all the treatments. Highest mycelial growth inhibition percentage was observed in case of tobacco leaf in cow's urine (100%), tobacco leaf and banyan leaf in cow's urine for 24 hours (100%), tobacco leaf and banyan leaf in cow's urine for 7 (seven) days (100%) and cow's urine (100%) at 70% concentration. In the case of 60% and 50% concentration the highest mycelial growth inhibition percentage (100%) was found in tobacco leaf and banyan leaf in cow's urine for 7 (seven) days (100%). The highest mycelial growth inhibition percentage (86.62%) was found in case of 40% concentration in tobacco leaf in cow's urine, in 30% concentration the highest growth inhibition (70.07%) was found in cow's urine and in 20% concentration the highest growth inhibition (64.62%) was found in turmeric rhizome extracts. In all the cases the number of spore production was zero in all the concentration of cow's urine and tobacco leaf and banyan leaf in cow's urine for 7 (seven) days. The number of spore production was high at lower concentration of all the treatment and the mycelial growth inhibition percentage was higher at the higher concentration of all the treatment.

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GENERAL INTRODUCTION

GENERAL INTRODUCTION

Wheat (*Triticum aestivum*) is cultivated in most parts of the world and second important food crop both in acreage and production. Wheat crop establishment is severely affected by both high soil and ambient temperature. Tolerance to heat at late stages of crop is important because it affects grain filling, resulting in smaller and shrivlled kernels (Acevedo, 1990). Tillage practices adopted for wheat cultivation vary widely based on the geographical region, infrastructural facility and economics of crop production (Saunders, 1993).

Relay cropping is the system of cropping in which the succeeding crop is sown before the harvest of the preceding crop. It is widely used for pulse cultivation with *Aman* rice in Bangladesh. However, information on Wheat-Transplanted aman (T. aman) cropping system is scarce. It has been reported that wheat seeds can be sown before 15 days of T. aman harvesting in areas of soil with high moisture content (Anonymous, 1990).

Late planting is a major problem in most wheat producing areas of Bangladesh. Late planting reduces the yield and efficiency of applied inputs to the crop. A linear decline in yield of 1-1.5% per day is observed when wheat is planted after the end of November irrespective of short or medium duration varieties (Hobbs and Giri, 1998).

A number of causes namely late precipitation, weed infestation, high temperature, and disease severity are associated for the reduction of wheat yield in rice-wheat relay cropping system. Among the stress diseases is one of the most important causes for the reduction of wheat yield.

Among the diseases spot blotch of wheat caused by *B. srokiniana* (Sacc. in Sork) Shoem, teleomorph *Cochliobolus sativus* is now the most destructive disease of wheat in the rice-based cropping system of Bangladesh (Anonymous, 1998).

Almost all released varieties showed varying degrees of spot blotch susceptibility. From a number of experiments over years the average yield loss was estimated as 15%. (Alam *et al.* 1998). The fungus also causes seedling blight, root rot, leaf spot and black point disease of wheat.

Efficacy of plant extracts for controlling seed-borne pathogens has been reported by Alice and Rao (1987), Suratuzzaman *et al.* (1994), Fakir and Khan (1992) and by other scientists at home and abroad. Different types of plant and plant products have been reported to control plant pathogenic fungi in the field (Bowers *et al.*, 2000; Lawson *et al.*, 1998).

Some farmers of Dakope Upazila of Khulna District have been using extracts of tobacco and banyan leaf in cow's urine effectively against insects and diseases instead of chemical pesticides (Nandi, 2007).

This study was undertaken with the following objectives-

1. To study the performance of wheat as a relay crop with transplanted aman rice in Khulna region.
2. To evaluate the efficacy of some biocides against *Bipolaris sorokiniana* causal agent of leaf blight/leaf blotch disease.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

RELAY CROPPING

Relay cropping under no tillage or reduced tillage condition has been practicing by the farmers in this sub-continent for attaining stability and diversity of farm output and for mitigating crop losses due to natural hazards and other reasons. A few research works on this aspect have been done yet. New avenues are being searched for matching particular crop to be cultivated as relay crop with others. Some important literatures related to the present work have been reviewed in this chapter.

A wheat crop was grown as relay crop to Transplanted Aman rice at Patuakhali Agricultural College farm during 1992-1993. The seeds were sown without treatment and many of the seedlings were died due to seedling blight. The rest of the seedlings had robust growth but no grains were formed. The temperature was high at the time of flowering that resulted pollen sterility (Personal communication)

Ahlawat and colleagues (1986) conducted a field experiment on relay cropping in rainfed groundnuts, with pigeon peas, sorghum and sesame intercropped 30, 45 and 60 days after sowing. Relay cropping of groundnut gave significantly higher pod equivalent yield and net returns than groundnuts in pure stands despite reduction in groundnut yield. Among relay crops, pigeon pea was the most remunerative irrespective of dates of intercropping. The earlier the relay crop was sown, the higher the pod equivalent yield and income obtained.

Torres and coworkers (1988) reported relay cropping maize into rice after intercropped cowpeas was not viable but pure stand cowpeas followed by maize gave the highest gross income and avoided end of season maize drought stress.

Purushotham and Shivashankar (1989) suggested that soybeans and cowpeas are too preferred as relay crops with early establishment of finger millet *(Eleusine coracana)* and no applied nitrogen.

Purushotham and Shivashankar (1989) suggested that soybeans and cowpeas are too preferred as relay crops with early establishment of finger millet *(Eleusine coracana)* and no applied nitrogen.

In 1985-88 rice *cv.* Jajati and Assamchudi were grown at 3 plant densities with Bengal gram *(Cicer arietinum) cv.* OG62, *Lathyrus sativus,* black gram cv. T9, lentils *cv.* T397, improved field peas *cv.* Rachna and local field peas as relay crops. Rice cultivar and density had no significant effect on yields of relay crops. *L. sativus* gave the highest mean seed yield of 0.22 t ha^{-1} and Black gram gave the lowest mean yield of 0.03 t ha^{-1}. Chickpea gave the highest mean net profit of $ 59.12 ha^{-1} (Barik and Sahoo, 1990).

Sandy loam potatoes *cv.* Kufri Chandramukhi were grown alone or intercropped with cut or uncut gobhi sarson *(B. campestries).* Potatoes were followed by fallow or relay intercrops of *T. alexandrinum cv.* Muscavi, onions *cv.* Pusa Red or wheat *cv.* WH 147 sown between the rows of sarson. Effect on yields of potatoes and relay crops were studied. Intercropping sarson with potatoes reduced potato yield by 9.12% and also reduced yields of relay crops, but total production was greater than in pure stands (Narwal, 1990).

Chandrasekaran and coworkers (1992) evaluated the triple cropping of rice based sequences in Tamil Nadu. Rice was transplanted in August; the succeeding legume crop was intercropped as relay on residual moisture and a third crop was grown under rainfed conditions. Rice cv. 9/black gram *(Vigna mungo) cv.* ADT 4/sesame cv. TMV 6 in the cropping system gave grain/seed yields of 6, 4, 1 and 0.6 t ha^{-1}, respectively.

Sivakumar (1993) compared the advantages of relay cropping, *Pennisetum glaucum* and cowpeas with improved management and intercropping under traditional management during the 1989-91 rainy seasons. The relay crops of both species produced more dry matter and leaf area and yielded more seeds/grains

than the intercrops, confirming that when the onset of rain was early, relay cropping *P. glaucum* and cowpeas was a better option than growing the same two species as sole crops.

In a field trial, Bhuiya and Hossian (1994a) observed that the seedlings of *Sesbania rostrata* transplanted as relay crop of boro rice before panicle emergence had no adverse effect on rice yield and *S. rostata* could be used as green manure for the succeeding transplant aman rice. In a separate experiment, (1994b) they found that *S. rostata* could be grown as relay crop with *aus* rice without disturbing the crop yield and could be used as green manure for the succeeding transplant aman rice.

Field trials were conducted by Das and Das (1998) with grasspeas *(Lathyrus sativus)*, lentil *(Lens culinaris)* and linseed *(Linum usitatissimum)* as rainfed paira crops to assess the weed population, weight, and allelopathic effects between crops and weeds. *Vicia* and *Melilotus* spp. were lowest in number and weight in paira linseed, indicating an allelopathic affect of the crop against these weeds, whereas the greatest number and weight of *Cyperus* spp. were found in linseed. The number of *Cyperus* spp. was lowest in grasspea plots.

Roy (1998) showed that the growth and yield of transplant aman rice were not affected by relay intercropping with different legume crops. The highest land equivalent ratio, gross return and rice equivalent yield were obtained from 25 cmapart rows of relay intercropping with mungbean and 25 cm apart rows of blackgram relay intercropping, respectively. Relay intercropping of mungbean produced the higher net return than rice sole.

Parajulee and Slosser (1999) Suggested a relay cropping system consisting of rape planted in the spring adjacent to wheat planted in the fall might be more efficient than using a single strip crop in a pesticide free cotton production system.

Pascua and colleagues (1999) conducted a long term field trial to determine yield trends in relation to nutrient uptake and efficiency in different rice based cropping system. They reported that a relay crop served as a catch crop for excess nutrients and as shade to minimize sunscald effects for tomato and sweet pepper fruits.

Roy (1999) conducted field trials in Bihar and compared different relay cropping of rice *cv.* Rajshree with *gram (Cicer arietinum)* linseed *(Linum usitatissimum)* cv. Subhra and lentils *(Lens culinaris)* cv. pant 406. Seeds of the relay crop were broadcasted in the 3rd week of November at 100 or 150% of the normal rate into standing crops of rice transplanted in July and harvested at the start of December. The relay crops were growed with or without NP fertilizers. Rice grain yield was not significantly affected by cropping system in either 1993/94 or 1994/95. Sowing rate had no effect on crop yields, while fertilizer application increased relay crop yield in 1994/95 only yield of the relay crop, and rice-equivalent yield of the cropping system, were greatest with linseed.

Production of the fodder legume *Lathyrus sutivus* was studied in the rice fields of farmers. Eight farmers broadcasted seeds of the fodder legume as a relay crop in standing aman rice. The integration of a fodder legume into a rice based cropping system is a practical solution to fodder shortage and that it restores soil fertility and improves milk yield and milk composition of dairy cows (Akbar *et al.*, 2000).

Martens and coworkers (2001) reported from their experiments that establishment and midseason dry matter of relay crops were not affected consistently by cereals. Relay crops did not affect main crop grain yield but did significantly reduce main crop dry matter production in some cases.

Chandrika and associates (2001) conducted a field experiment in India to evaluate the yield and economics of different cropping systems in rainfed Alfisols. They reported that groundnut + pigeonpea relay intercropping gave higher total yield advantages and net returns.

Studies on comparative productive efficiency and feasibility of' different rice--based cropping systems both at conventional and zero tillage were carried out by Malik and coworkers (2002). All the crops were sown during the third week of November 1999 and harvested (except berseem) in the first weak of May 2000. Among the various rice based cropping systems, rice-chickpea recorded the maximum monetary benefit both at conventional and zero tillage followed by rice-berseem, rice-barley, rice-lentil and rice-wheat.

Vliet (2002) reported intercropping silage maize with a relay crop Italian ryegrass *(Lolium multiflorum)* reduced the mean annual runoff and suspended solid load of nutrients.

PLANT EXTRACTS FOR CONTROLLING DISEASES

Lapis and Dumancas (1978) evaluated that aqueous extracts of 93 plants screened against *Helminthosporum oryzae*, 42 inhibited its growth. The extracts were active at 1:10 aqueous. solutions expecting for *Euphorbia pulcherrima* which was only active in its concentration form. The precipitate was generally more active than the supernatant, and actively decreased with time. *Impatiens balsamina*, *Pseudocalyma alliaceum*, garlic and *Tagetes erecta* were further evaluated *in vitro*. *Impatiens balsamina* extracts were active as a therapeutant and protectant against the pathogen on rice while the other 3 were effective therapeutants only.

Tripathi and associates (1978) reported that the fungitoxic effect of higher plants *Lawsonia inermis* and found that the extract of Lawsonia leaves exhibited strong fungitoxicity. The anti-fungal factor was 2-hydroxy, 1, 4-naphthoquinone (Lawsone). The main effective dose against the test fungus *Helminthosporum oryzae* (*Cochliobolus miabeanus*) was 10000 ppm. Lawsone is fungicidal, with a wide fungitoxic spectrum and is non-phytotoxic.

Dharma and Sharma (1985) reported that neem oil inhibited the growth of *Alternaria alternata* 61.1% at concentration of 1% and by 100% at 10% concentration.

Alice and Rao (1986) worked on management of seed borne *Drechslera oryzae* of rice with plant extracts and found that *Mentha piperira* and *Allium sativum* extracts significantly reduced seed-borne infection of *D. oryzae* and observed that seeds treated with extract produced seedling of larger shoots and roots than those in the untreated check.

EI-Shami and coworkers (1986) tested anti-fungal property of garlic clove juice against Fusarium wilt of water melon. The garlic extracts inhibited spore germination and mycelial growth of *Fusaarium oxysporium* f. sp. *niveum.*

Alice and Rao (1987) evaluated 31 plant extracts *in vitro* on *Drechslera oryzae* in rice the paper disc technique (inhibition zone technique) and found that maximum inhibition of *D. oryzae* was obtained with *Mentha piperira,* followed by *Piper nigrum* seed extract and *Allium sativum* extract.

Asad and Behroozin (1987) performed an experiment with bulb extracts of onion and garlic and ob served the effect of these extracts on mycelial growth of *Fusarium spp.* and *Sclerotium cepivorum.* Garlic extracts were found more active than that of onion in inhibiting growth of *F. solani, F. oxysporum* and *F. acuminatum.*

Chalfo and Carvalho (1987) studied the inhibition of mycelial growth of *Gibberella zeae* (Fusarium growth) by means of treatments with garlic extract compared to chemical fungicide captafol. All treatments inhibited mycelial growth of *G. zeae.* The most effective concentration being 8000 and 1000 ppm for garlic extract and 1000 ppm for captafol.

Nataranjan and Lalithamumari (1987) reported that the activity of leaf extract (*Lawsonia inermis*) against *Drechslera oryzae* (*C. miabeanus*) was tested at 1:40 dilution (E_{50} conc.) by measuring the growth, protein, DNA, RNA synthesis and O_2 uptake. O_2 uptake was inhibited most. The anti-fungal factor contained in the

found that all the extracts inhibited growth to various degrees but garlic bulb extract was more effective than other extracts employed in the test.

Tewari and Mandakini (1991) reported the activity of four plant leaf extracts against three fungal pathogens of rice and found that *Piper betle, Ocimum sanctum, Nyctanthes arbortristis* and *Citrus lemon* were effective in reducing the radial growth of *Pyricularia oryzae, C. miabeanus* and *Rhizoctonia solani in vitro*, with extracts of *P. betle*, followed by *O. sanctum* the most effective. Extracts from these two species were also effective for controlling spread of the pathogens *in vitro*, where as *N. arbor-tristis* and *Citrus lemon* were not effective.

Ashrafuzzaman and Hossain (1992) reported that pudina (*Mentha viridis*) extract evaluated against *Bipolaris sorokiniana* inhibited mycelial growth and spore germination. In the same work they have found that extract of castor (*Ricinus communis*) and Dantha kalash (*Leucas aspera*) were also inhibitory against mycelial growth and spore germination of *Bipolaris sorokiniana*.

Ashrafuzzaman and Khan (1992) studied sclerotial formation and mycelial growth of *Rhizoctonia solani* in vitro. They found no sclerotial formation using garlic extract against abundant sclerotial formation in case of control. Diameter of mycelial growth was 3.4 cm against 9.0 for control.

Fakir and Khan (1992) showed that garlic bulb extracts were effective in controlling seed borne fungal pathogens of jute such as *Macrophomina phaseolina* and *Fusarium* spp. by seed treatment. They also reported garlic bulb extract at different concentration reduced significantly the seed borne infection of *Colletotrichum corchori, Fusarium* spp and *Macrophomina phaseolina* in jute. Both concentrated garlic extracts and vitavax-200 were more or less equally effective in controlling *M. phaseolina* reducine 90.9% and 87.9% seed borne infection of the pathogen respectively. More than 80% control of seed borne infection of *Fusarium* spp. was achieved with concentrated and 4:1 garlic extract. Garlic extracts appeared to be less effective for *C. corchori*, reducing only 14.3%

to 57.1% seed borne infection of the pathogen depending on the concentration of the extract. Good germination was recorded in case of all the dode of garlic extract used. However, some phototoxic effect was noted on germination seeds with concentrated dose garlic extract.

Khan and Kumar (1992) reported that seed treatment with Garlic extract, Neem, Ginger, Gagra, Biskatali leaf extract reduced seed-borne prevalence and it also increased germination percentage of wheat seeds. Among them Garlic and Neem bark gave better results.

Rahman (1992) evaluated the activity of vitavax-200 and garlic extract against *Drechslera* sp., *Fusarium* sp., *Rhizoctonia* sp on the ability to retard spore germination and mycelial growth. He observed vitavax-200 and garlic extract almost equally inhibited spore germination and arrested mycelial growth of fungi.

Extracts from the root of pea (*Psium sativum*) seedlings inhibited the mycelial growth/ sclerotial production of *Rhizoctonia solani,* and *Botrytis cinerea* (Schenk *et al.,* 1991). Lemon grass (*Cymbopogon citrates*) oil was found to be effective against *Rhizoctonia solani* and *Sclerotiana sclerotiorum*. This finding was supported by Hossian *et al.* (1993

Hossain and coworkers (1993) reported that extracts of *Lawsonia alba, Ipomoea fistulosa, Allium sativum* and *Leucas aspera* when screened for their anti-fungal property against *Bipolaris sorokiniana,* only *A. sativum* completely inhibited the mycelial growth at dilution ratio of 4:1 (w/v). They also found that the extract of Mehedi *(Lawsonia alba*) was inhibitory against *Bipolaris sorokiniana.*

Khan and Hossain (1993) observed that extracts of *Allium cepa, Allium sativum, Datura stramonium, Datura plumeiri, Lawsonia alba, Ricinus communis, Leonurus sibirisus* and *Mentha viridis* completely inhibited spore germination of *Bipolaris sorokiniana* at 1:3 dilution ratio.

Tewari (1993) reported that aqueous and ethanol extracts of *Amorphophallus bulbifer, Michelia champaca* and *Zizyphus jujube* leaves were tested against *Pyricularia oryzae, C. miabeanus* and *R. solani*. The most toxic extracts against *P. oryzae* were an ethanol extract of *M. champaca* followed by *Z. jujube*. *Z. jujube* also had broad spectrum inhibitory activity against *C. miabeanus* and *R. solani.*

Ganesan (1994) evaluated the aqueous leaf extracts of 30 species, mainly woody and including several medicinal species were assayed for activity against *D. oryzae* (*C. miabeanus)*. Extracts of *Anacardium occidentale, Bixa orellana, Ichnocarpus frustescens, Leep sp., Macaranga peltat* and *Uvaria narum* completely inhibited conidial germination. Germtube elongation was inhibited by extracts of *Cleome aspera, Delonix regia, Gliricidia sepium, Hibiscus surattensis, Quisqualis indica* and *Zornia gibbosa.*

Ganguly (1994) reported that leaf extracts of *Vinca rosea, Lantana camara, Ocimum tenuiflorum, Solanum melongena, Azadirachta indica, Polyanthi longifolia, Aegle marmelos* and *Datura metel* showed anti-fungal activity against *Pyricularia oryzae and H. oryzae* in vitro. Extracts of *V. rosea* showed inhibition of mycelial growth and spore germination.

Plant extracts have been reported to be anti-fungal by many researchers (Kishori *et al.* 1982; Asthana *et al.* 1986; Naidu, 1988; Ashrafuzzaman and Hossian, 1992; Hossian *et al.*, 1993 and Suratuzzaman 1994).

Aggraeni and Suharti (1995) examined the effect of garlic extract and *Trichoderma sp.* in inhibiting the growth of the pathogen *Botryodiplodia sp. in vitro*. Root rot diseased caused by *Botryodiplodia sp.* is a problem in young plantation. *In vitro* tests showed that both garlic extract and a suspension of *Trichoderma sp.* were effective in inhibiting growth of *Botryodiplodia.*

Arun and coworkers (1995) found that the extract of garlic bulb was effective in suppressing radial growth of the pathogen *Fusarium* and *Sclerotium* and was more effective when added after sterilization.

Barros and associates (1995) worked on the effect of garlic extracts on germination and mycelial growth of *Phytophthora parasitica, Curvularia brachyspora, C. pallescens* (*Cochliobolus pallescens*), *Alternaria laternata* and *A. longipes*. For testing the mycelial growth inhibition, the extract concentration were 250, 500, 1000, 2000, 5000 and 10,000 ppm through incorporation in PDA medium at 45^0C. For the germination test, the extract concentration was 100, 250, 500 and 1000 ppm in distilled water. The garlic extract did not affect spore germination of the 5 species. But the mycelial growth of all the species were affected at 250 ppm, and the reduction of colonies diameter was related to the increase of the extract concentration.

Bisht and Khulbe (1995) evaluated the leaf extract of 10 plants against *D. oryzae* in vitro. All extract exhibited fungitoxic properties and significantly reduced mycelial growth. Maximum inhibition was reported by plant extract from *Junlans regia, Allium sativum, Origanum vulgara* and *A. wallichii*.

Kazmi and associates (1995) conducted an experiment to see the effect of neem oil on *in vitro* growth of root infecting fungi. The effect of neem oil on the growth of the root infecting fungi *Macrophomina phaseolina, Rhizoctonia solani* and *Fusarium moniliforme (Gibberella fujikuroi*) was examined. Neem showed greater suppression of growth of *Rhizoctonia solani* and *Gibberella fujikuroi.*

Khan and Fakir (1995) treated the seed of jute with garlic extract to control seed borne pathogens. Seed treatment with garlic extract at different concentration significantly reduced seed borne infection by *Colletotrichum corchori*, Fusarium spp. and *Macrophomina phaseoliolina* in jute. Both concentration of garlic extract and carboxin (as Vitavax-200) were more or less equally effective in controlling *Macrophomina phaseoliolina* but garlic extract appeared to be less effective in controlling *Colletotrichum corchori.* Good germination was recorded following all treatments when garlic extract was used.

Suratuzzaman (1995) reported that in soybean, seed treatment by extract of garlic and ginger resulted an excellent controlling effect on seed-borne *Colletotrichum damatium* var. *truncatum*, *Macrophomina phaseolina* and *Cercospora kikkuchi*. Gohil and Vala (1996) investigated the activity of 33 plant extracts against *F. moniliforme* (*Gibberella fujikuroi*). Garlic and *Sopindus trifoliate* were inhibitory; garlic extracts being the most effective.

Pandey and coworkers (1996) evaluated the activity of plant latex towards certain fungal organisms and found that latex from *Jatropha gossypiifolia* and *J. tanjorensis* was highly fungi-toxic. *J. gossypiifolia* latex inhibited conidial germination of *H. oryzae* (*C. miabeanus*) and *Alternaria brassicicola* by 100%. Some toxicity was retained even after 25 fold dilution. Growth of *C. miabeanus* on agar containing the latex was also suppressed.

Hossain and coworkers (1997) reported that extracts of *Allium sativum* and *Lawsonia alba* was effective in reducing spore germination and mycelial growth of *Bipolaris sorokiniana*, *Nigella sativa* showed positive anti-fungal activity in reducing the pathogenecity of *B. sorokiniana* on wheat leaves.

Volf and Steinhauer (1997) made an experiment to evaluate the fungicidal effect of neem leaves. After evaporation of the methanolic extract of ground dry leaves, the residue was redissolved in a small amount of methanol and added to an agar medium. Growth of the test fungi *Drechslera avenae* (*Pyrenophora chaetomioides*) and *Fusarium culmorum* was inhibited by 10-65%, depending on the fungus sensitivity and the origin of the leaves (India and Dominican Republic). Powdery mildew of cucumber (*Sphaerotheca fuluginea*) was not inhibited by the extracts; the growth of the fungus was even promoted. Black spot of roses (*Diplocarpon rosae*) was influenced by one extract (origin Dominican Republic) in a detached leaf assay. The size and number of acervuli, the formation of yellow hallows and the numbers of conidia/mm2 were reduced. For the detection of fungicidal compounds, the extracts were cleaned up by liquid-liquid

partition and the fractions tested against the sensitive fungus *P. palmivora*. The growth of the fungus was inhibited by 66-72% depending on the fraction.

Zaman and coworkers (1997) worked on seed borne fungi on mustard and their control with indigenous plant extracts. Seven fungal genera namely *Alternaria*, *Fusarium*, *Aspergillus*, *Rhizopus* were associated with mustard seeds. Four plant extracts tested were effective in decreasing the prevalence of seed borne fungi. However, garlic and neem leaf were superior among the extracts followed by ginger and onion bulb. All the extracts gave highest control when used in crude form and their efficacy declined with increasing dilution.

Enikuomehin and coworkers (1998) worked on the evaluation of ash from some tropical plants of Nigeria for the control of *Sclerotium rolfsii* Sacc. On wheat (*Triticum aestivum* L.). Nine tropical plants were screened for their abilities to inhibit mycelial growth and sclerotial germination of Nigerian isolate of *C. rolfsii* (Corticium *rolfsii*) on agar and in the soil. Of the 11 samples tested 10 showed some activity against mycelial growth of *C. rolfsii in vitro.*

Moniruzzaman and Ashrafuzzaman (1998) applied garlic (*Allium sativum*), neem (*Azadirachta indica*) and tobacco (*Nicotiana tabacum*) against Alternaria blight of mustard. Crude extracts of 3 plants were significantly highly effective pod produce percent plant infection, percent leaf infection and percent leaf area diseased. In promoting plant height, number of siliqua per plant, number of seeds per siliqua, thousand seeds weight and yield per plant. The garlic bulb crude extracts 1:1 were found best among the all treatments.

Yin-Mei Chin and associates (1998) examined the inhibitory effects of water-soluble extracts of garlic bulbs, green garlic, green onions (*Allium fistulosum* var. *caespitosum*), hot peppers, ginger, Chinese parsley (*Coriandrum sativum*), and basil (*Ocimum basilicum*) on the growth of *Aspergillus niger* and *A. flavus* and *Phytophthora parasitica*. Garlic bulbs, green garlic, green onions showed an inhibitory effect against these fungi.

Blaeser and associates (1999) worked on six extracts from plant material (*Galla chinensis, Potentilla erecta, Rheum rhabarbarum, Salviae officinalis, Sophera flavescens,* and *Terminalia chebula*) for controlling effects against the infection of *Phytophthora infestans* on detached potato leaves, seedlings and tuber slices. On detached leaves, *G. chinensis* (2%), *R. rhabarbarum* (rhizome, 2%) and *S. flavescens* (2%) extracts showed a significant control effect, with a control efficacy 96.67%, *G. chinensis* was the best. On seedlings *R. rhabarbarum* (rhizome, 2%) showed the best inhibiting effect, followed by *S. flavescens* (2%), *T. chebula* (1%), and *G. chinensis* (2%). The control efficacies were 91.67%, 75.00%, 70.24% and 64.29%, respectively on the seventh days after inoculation. On potato slices, none of the plant extracts showed effective protection against infection and sporangia production of *Phytophthora infestans*.

Rahman and associates (1999) found that Biskatali (*Polygonum hydropiper*), garlic *(Allium sativum*), ginger (*Zingiber officinale*) and neem (*Azadirachta indica*) extracts were effective against seed borne infection *Alternaria tenuis, A. alternata, Bipolaris sorokiniana, Fusarium spp.* of wheat. However, garlic was found superior to the other extracts followed by ginger and neem.

Ribeiro and Benendo (1999) evaluated the effect of plant extracts on the growth and sporulation of *Colletotrichum gloeosporioides* (*Glomerella cingulata*) aqueous extracts from garlic, peppermint (*Mentha piperita*), castor bean (*Ricinus communis*) and peppers (*Capsicum spp.*) were incorporated into Potato Dextrose Agar (PDA). Garlic extract inhibited mycelial growth by 53-67.6%. Peppermint, castor bean and pepper extracts promoted mycelial inhibition and reduced conidia production by 41-84% depending on the extract concentration.

Ahmad and Islam (2000) observed neem (*Azadirachta indica*), garlic (*Allium sativum*), onion (*Allium cepa*) and biskatali (*Polygonum hydropiper*); among that neem and garlic extracts were effective against *Bipolaris oryzae* at 1:1 dilution.

Okemo and colleagues (2003) carried out *in vitro* test using extracts of *Maesa lanceolata* var. *goulungensis* weir against a broad range of fungal plant pathogens such as *Fusarium oxysporum, Rhizoctonia solani* and *Sclerotium rolfsii M. lanceolata* extracts were very active against all the pathogens tested except *P. ultimum* and *R. solani.*

Rashid (2003) observed that seed borne fungi were detected on two soybean gerplasm (PB^{-1} and BS_3) and an attempt has been made to control them by different plant extracts. Although vitavax-200 was found best as seed treating agent for reducing fungal population, among seven plant extracts of gada and neem were found better.

Anonymous (2004) has stated garlic tablet is a botanical fungicide. It has a great medicinal value against both plant and human diseases. The tablet has been proved effective in plant disease control, especially for seed-borne diseases.

Curtis and coworkers (2004) mentioned that the activity of garlic extract in vitro against the pathogenic fungi *Altenaria brassicicola, Botrytis cinerea, Plectosphaerella cucumerian, Magnaporthe grisea* and *the Oomycete Phytophthora infestans*. Disease reduction in plant was shown for *Magnaporthe grisea* and the *Oomycete Phytophthora* infestans. Disease reduction in plant was shown for Magnaporthe grisea infected rice, *Hyaloperonospora parasitica* infected Arabidopsis thaliana and *Phytophthora infestans* infected potato tubers. Significantly the active principle was effective in reduce *P. infestans* spore germination in vitro and disease in blighted tubers via the vapour phase (fumigation) as well as direct application at the inoculation site. They also reported that the volatile antimicrobial substance allicin is produced in garlic after cellular decompartalisation when rhe tissues are damaged and the substrate allicin mixes with the enzyme allicin-lyase (E. C. 4.4, 1.4). The effectiveness of garlic extracts against a range of plant pathogenic organisms was tested in vitro and plant in diseased tissues. Allicin in garlic extract was quatified spectrophotometrically and a rapid bioassay was developedc for routine use. The

in vitro activity of allicin against a phototrophic E. coli isolate was compared with that of the conventional antibiotics Amlicillin and Kanamycin.

Rukhsana (2005) reported the antifungal activity of plant extracts and growth response of some pathogenic fungi. The research work was designed to evaluate the potentiality of aqueous extracts of neem (*Azadirachta indica*) against three pathogenic fungi *viz. Drechslera tetramera, Aspergillus niger* and *Phoma glomerata.* A highly contrasting response was exhibited by the test pathogens to employed extract treatments. The concentration of 10, 20 and 30% extract exhibited antifungal activity resulting in a pronounced decrease in fungal biomass production.

Ogechi and coworkers (2006) worked on the *in vitro* assay of some plant extracts against *Fusarium oxysporum* f. sp. *lycopersici* causal agent of tomato wilt. The effect of crude extract of neem (*Azadirachta indica* L.) leaf, neem seed and garlic (*Allium sativum*) at concentration ranging from 5% to 30% of the material in 100 ml of Potato Dextrose Agar on mycelial growth on *Fusarium oxysporum* f. sp. *lycopersici* was assessed. All the extracts inhibited mycelial growth at various levels. Dry neem seed extracts gave 100% inhibition of mycelial growth. Fresh neem leaf extracts reduced mycelial growth with increasing concentration while in garlic there were no differences in growth inhibition among the various concentration used. However garlic extracts decreased sporulation with increasing concentration and culture grown on extract amended agar plates remained viable.

CHAPTER-I

INTRODUCTION

CHAPTER I

PERFORMANCE OF WHEAT AS A RELAY CROP WITH TRANSPLANTED AMAN RICE AT DIFFERENT DATES OF SOWING

INTRODUCTION

Wheat (*Triticum aestivum*) is cultivated in most part of the world and second important food crop both in acreage and production. Wheat crop establishment is severely affected by both high soil and ambient temperature. Tolerance to heat at late stages of crop is important because it affects grain filling, resulting in smaller and shrivlled kernels (Acevedo, 1990). Tillage practices adopted for wheat cultivation vary widely based on the geographical region, infrastructural facility and economic of crop production (Saunders, 1993). Zero tillage is defined as the operation of planting crops in previously unprepared soil by opening a narrow slot or band only of sufficient width and depth to obtain proper seed placing. No tillage and reduced tillage have been being used since ancient times as indigenous practice (Harfield and Karlen, 1992). Crop production in zero tillage or no tillage condition is one of the technologies for resource conservation in agriculture. Compared to conventional tillage, no tillage has numerous agronomic advantages (Sayre, 1998; Beck *et al.*, 1999). This system for wheat has been practiced consistently over 15 years in Brazil (Viera and Kochan, 1990) and in many other countries also.

Relay cropping is the system of cropping in which the succeeding crop is sown before the harvest of the preceding crop. It is widely used for pulse cultivation with *Aman* rice in Bangladesh. However information on wheat-Transplanted aman (T. aman) cropping system is scarce. It has been reported that wheat seeds can be sown before 15 days of T. aman harvesting in areas of soil with high moisture content (Anonymous, 1990).

The optimum period for wheat cultivation is determined by the dates among which temperature normally remains below about 27^0C. Temperatures above that

level during early growth stage reduce tiller formation. Higher temperature at late growth stage reduces grain formation; in combination with moisture stress, they may also cause premature ripening and shriveling of grain. Sowing later than December means that the crop will head and flower when day temperature start rising above the critical temperature, and result in considerable yield reduction. The wheat growing season near the coast is limited greatly by the relatively short duration of the cool winter. This drawback can be overcome by adjusting the sowing time (Acevedo, 1990).

The demand of food production is increasing day by day along with the increasing population. But the cultivable land is decreasing. To meet up the food supply, now one of the pressures of food production is to increase yield per unit area of land.

The cropping intensity of Khulna region is usually lower than other region. If wheat is incorporated in the cropping pattern, it will obviously increase the production in this region. Wheat cultivation after the harvest of T. aman rice reduces the length of wheat growing period. The crop also suffers from high temperature during the flowering phase as the winter is short. Increasing the growing period by adjusting the sowing time would be the only option. So, relay system of cropping can be adopted to overcome the problem. The present study was undertaken to identify the appropriate time of sowing for wheat in relay cropping system with T. aman rice in Khulna region.

MATERIALS AND METHODS

MATERIALS AND METHODS

The research project was conducted at the experimental field of Agrotechnology Discipline of Khulna University in Rabi season during November 22, 2005 to March 27, 2006.

The variety Kanchan was used as a planting material. The seeds were treated with vitavax-200 before sowing in order to reduce the incidence of spot blotch caused by *Bipolaris sorokiniana*. The wheat seeds were sown in between two rows of T. aman rice. The seeds were sown at 8 day intervals beginning from November 22, 2005 to December 24, 2005.

Treatment

The seeds were sown in five different dates. The proposed 8 sowing dates experiment was designed with starting from 1st November to 20th December at eight days interval but the proposed dates had to reduce to five dates instead of eight due heavy precipitations in October. Late sowing dates were 22nd November, 30th November, 8th December, 16th December and 24th December, 2005.

Design

The research project was laid out in a Randomized Complete Block Design (RCBD) with five treatments and three replications. The size of the total field was 19 m × 16 m. The plot size was 4 m × 3 m. The blocks were separated by 1 m wide space. The distance from plot to plot was 0.5 m.

Seed treatment

Before 24 hours of sowing the seeds were treated with Vitavax-200 at the rate of 2.5 g per kg seed. The treated seeds were kept in a beaker covered with alluminium foil.

Seed sowing

Seeds were sown in furrow line at the rate of 240 kg ha^{-1}. The furrows were made by an iron rod. The rice crop was harvested after five days of last sowing.

Weeding

Weed infestation was so severe that the wheat crop faced serious stress during the early stage of its growth. Major weeds were *Cynodon dactylon* and *Cyperous rotandus* and they covered soil surface of the field. Weeding operation was done one time manually.

Fungicide application

Although seeds were treated with Vitavax-200 the plants were attacked severely by a fungus *Bipolaris sorokiniana* and caused seedling blight, leaf spot and leaf blotch symptoms. Tilt-250 EC was sprayed for three times at the rate of 0.05% to control *Bipolaris sorokiniana.*

Fertilizer application and Irrigation

Nitrogenous fertilizer was applied twice in line at the rate of 62.5 kg/ha. First application of fertilizer was done at 24th January 2006 and the second application of fertilizer was done at 8th February. Irrigation was done in line immediately after fertilizer application with the help of water cane.

Harvesting

The crop was harvested at full maturity. The harvested crop of each plot was bundled separately and tagged. Ten sample plants were selected randomly from each plot during harvesting and separated. Harvesting of treatment A (22 November sowing) and treatment B (30 November sowing) was done on 14th March and the crop of other treatments was harvested on 27th March.

Data collection

Data were recorded from ten randomly selected plants in each plot. Grain and straw yield were recorded from the selected ten plants for each plot. The grain and straw weight were expressed in ton per hectare. The thousand (1000) grain weight was taken from the dried grain samples from each unit plot. Data on plant height (cm), panicle length (cm), number grain panicle^{-1}, weight of 1000- grain (g), grain yield (t ha^{-1}), and straw yield at 0% moisture content were recorded. For the calculation of biological yield and harvest index the grain and straw was dried in oven at 70^{0}C for 72 hours. Biological yield and harvest index was calculated from the following formula-

Biological yield = grain yield + straw yield.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

All the data were collected after harvesting of crop and the average value was calculated. Thousand (1000) grain weights were calculated by using an Electric Balance.

Analysis of Data

The collected data on different parameters were analyzed following analysis of variance (ANOVA) technique by using MSTAT-C program. Means were compared by least significant difference (LSD) test.

RESULTS

RESULTS

Wheat variety Kanchan was grown during Rabi season as relay crop to transplanted aman in zero tillage condition. The general growth condition of the crop was not good. Weather condition specially late precipitation, weed infestation, disease appearance and late sowing created a stress condition for crop growth. However, statistical analysis revealed that there were significant treatment (Dates of sowing) effects for all the parameters except 1000- grain weight (g).

Plant height (cm)

Plant height was affected significantly ($p<0.01$) by dates of sowing. It was observed that earlier sowing produced tall plants (Table 1). Plant height in the experiment ranged from 14.9 cm to 18.7 cm. The longest plant (18.7 cm) was observed in treatment of 22nd November sowing. The shortest plant (14.9 cm) was observed in treatment where seeds were sown on 24th December. Plant height was found decreasing with time of sowing except for the plant height at 16th December sowing which was slightly but non-significantly higher than 8th November sowing.

Spike length (cm)

Different dates of sowing showed significant effect on the length of spike. The length of spike varied from 1.6 cm to 2.2 cm (Table 1). The longest spike (2.2 cm) was observed in treatment of 22nd November sowing which was statistically identical to treatment of 30th December sowing. The shortest spike (1.6 cm) was observed in treatment of 8th December sowing. Results showed that spike length (cm) in December sowing was significantly reduced as compared to November sowing.

Number of grain spike^{-1}

Early sowing had significant effect on the number of grain spike^{-1}. The number of grain ranged from 15 to 24 (Table 1). The highest number of grain spike^{-1} was

obtained from treatment of 22nd November sowing and that was also similar to 30th November sowing and the lowest number of grain spike^{-1} was obtained in treatment where seeds were sown on 24th December. Here significant reduction was also occurred in December sowing than November sowing

Weight of 1000- grain (g)

Thousand grain weight (g) was found non significant. Weight of 1000- grain varied from 25.27 g to 27.51 g (Table 1).

Grain yield (t ha^{-1})

There was significant variation among the treatment regarding grain yield. Grain yield varied from 0.63 t ha^{-1} to 1.65 t ha^{-1} (Table 1). The highest grain yield (1.65 t ha^{-1}) was obtained from treatment where seeds were sown on 22nd November and the lowest grain yield was obtained from treatment of 24th December sowing. The same yield (0.88 t ha^{-1}) was obtained in two dates of sowing (December 8 and December 16). It is clear from the table that there was a decreasing trend of yield from early to late sowing except for 12th December sowing which was equal to 8th December sowing.

Biological yield (t ha^{-1})

Different dates of sowing showed significant effect on the biological yield of wheat ($p< 0.01$) (Table 1). Biological yield varied from 1.15 t ha^{-1} to 3.39 t ha^{-1}. The highest biological yield (3.39 t ha^{-1}) was obtained from treatment of 22nd November sowing followed by 30th November sowing and the lowest biological yield (1.15 t ha^{-1}) obtained from treatment of 24th December sowing which was statistically similar to other dates of sowing in December. The result indicated that late sowing resulted lower biological yield. It means that early sowing would be effective for higher yield owing to higher biological yield.

With the advancement of sowing dates both grain yield and biological yield decreased. On the other hand with the increase of biological yield (t ha^{-1}) the grain yield (t ha^{-1}) was increased (Fig. 1). They were positively related. Regression

equation between biological yield (t ha^{-1}) and the grain yield (t ha^{-1}) also revealed that almost 99% of the variation in grain yield (t ha^{-1}) could be explained by the variation of biological yield (t ha^{-1}).

Harvest index (%)

The effect of dates of sowing on harvest index was significant at 5% level of probability (Table 1). Harvest index varied from 46.45% to 55.30%. The highest harvest index (55.30%) was obtained from treatment of 24th December sowing which was significantly higher than other treatments except for 8th December sowing. The lowest harvest index (46.45%) was obtained from treatment B of 30th November sowing which was similar to the treatments of 22nd November 16th December sowing. The results indicated inconsistency in biological yields of different treatments.

Grain yield (t ha^{-1}) was increased with the increase of biological yield (%) (Fig. 1). So, they were positively related. Regression equation between grain yield (t ha^{-1}) and biological yield also revealed that over 98% of the variation in Grain yield (t ha^{-1}) could be explained by the variation of biological yield (%). From fig. 2 the value of R^2 (0.9068) revealed that over 90% of the variation in grain yield could be explained by the variation in harvest index.

Table1. Effect of different dates of sowing on different agronomic characters of wheat as a relay crop with Transplanted aman (T. aman) rice

Treatment	Plant height (cm)	Spike length (cm)	Grain per spike	Thousand grain weight	Grain yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
A (22nd November sowing)	**18.7**	**2.2**	**24**	27.39	**1.65**	**3.39**	48.54
B (30th November sowing)	17.7	**2.2**	22	**27.51**	1.36	2.97	46.45
C (8th December sowing)	16.2	1.6	16	25.65	0.88	1.72	51.34
D (16th December sowing)	16.7	1.8	18	25.65	0.88	1.90	46.96
E (24th December sowing)	14.9	1.7	15	25.27	0.63	1.15	**55.30**
CV (%)	4.90	9.52	10.42	6.36	19.68	16.06	5.49
Level of significance	**	**	**	NS	**	**	*
$LSD_{(0.01)}$	1.555	0.3368	3.622	3.149	0.825	0.3261	-
$LSD_{(0.05)}$	-	-	-	-	-	-	1.270

** = Significance at 1% level of probability

* = Significance at 5% level of probability

NS = Non significant, LSD= Least significant difference

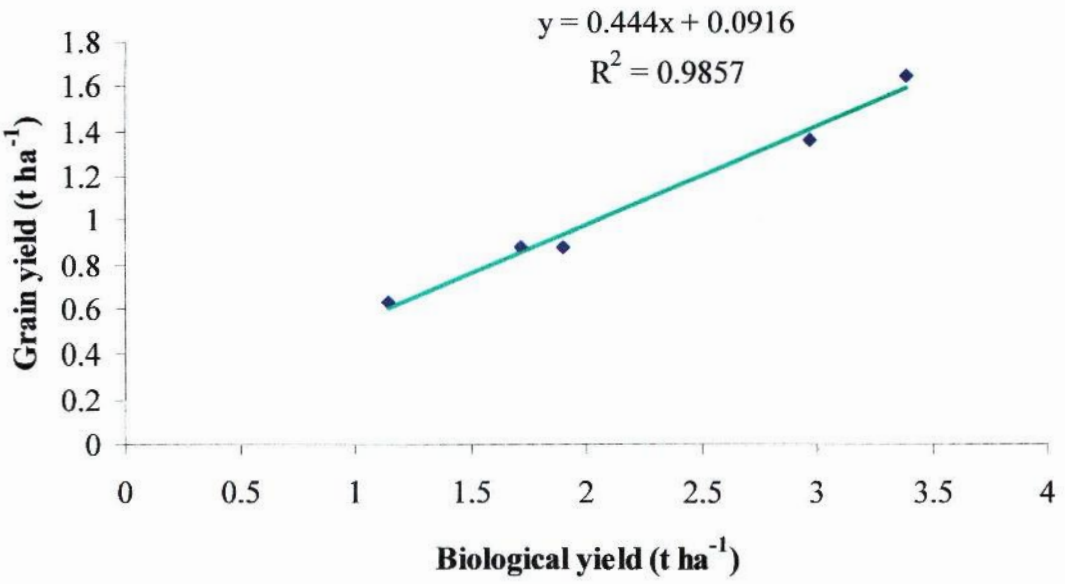

Fig. 1. Functional relationship between biological yield (t ha^{-1}) and grain yield (t ha^{-1}) of wheat

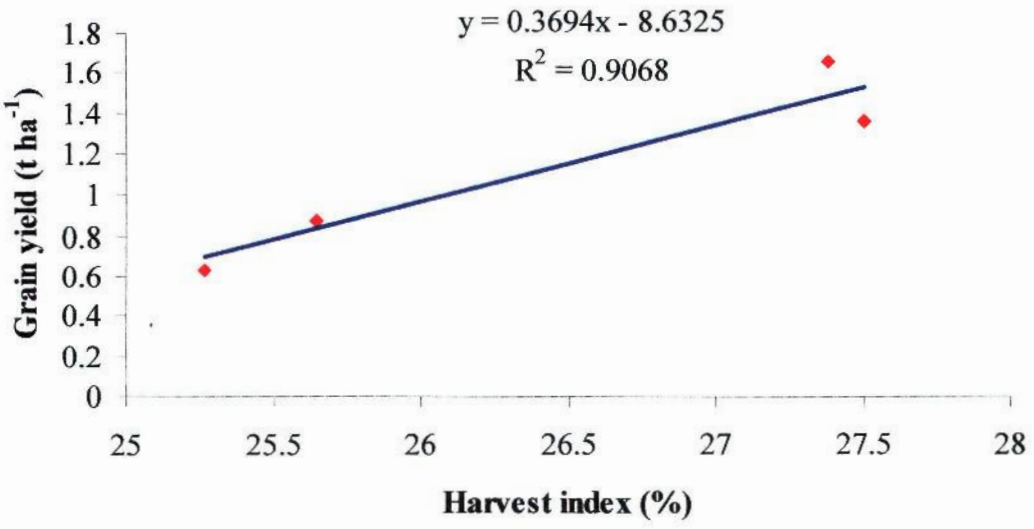

Fig. 2. Functional relationship between grain yield (t ha^{-1}) and harvest index (%) of wheat

DISCUSSION

DISCUSSION

The usual plant height for Kanchan is 90-100 cm. In all treatments extreme shorter plant height (14.9-18.7 cm) was observed than the usual plant height of the Kanchan variety. The usual panicle length of Kanchan is 8-10 cm but here the panicle length (1.6-2.2 cm) was much shorter. The usual number of grain spike^{-1} for Kanchan is 35-40. In the present experiment the observed number of grain spike^{-1} was 15-24. The usual 1000-grain weight and yield for Kanchan were 40-45 g and 3.8-4.0 t ha^{-1} respectively. But the observed 1000-grain weight and yield were 25.27-27.51g and 0.63-1.65 t ha^{-1}which was much lower.

The optimum period for wheat cultivation is determined by the dates between which one temperature normally remains below about 27^{0}C. Temperatures above that level during early growth stage reduce tiller formation. Higher temperature at late growth stage reduces grain formation; in combination with moisture stress, they may also cause premature ripening and shriveling of grain (Saunders, 1993).

The temperature and moisture condition prevailed at the time when the experiment was carried out were not optimum for wheat. So the usual growth and development of the crop was hampered and all results of the parameters were much lower than the usual ones.

Late planting is a major problem in most wheat producing area of Bangladesh. Late planting reduces the yield and efficiency of applied inputs to the crop. A linear decline in yield of 1-1.5% per day is observed when wheat is planted after the end of November irrespective of short or medium duration varieties (Hobbs and Giri, 1998).

Precipitation during the growing period of this experiment was higher than the previous season and the next season (appendix 1) and the crop is infested by weeds and severely infected by disease leaf blotch/leaf spot caused by *Bipolaris sorokiniana*.

In the month of October (appendix 1) the soil moisture was high during the study period. This condition favoured heavy weed infestation which could not be controlled successfully. High soil moisture and stress due to weed infestation created favourable condition for occurring seedling blight and later leaf spot/leaf blotch disease although treated seeds were used. Due to late sowing, weed infestation, disease and high temperature during both growth and reproductive stage created a heavy stress condition for the crop and as a result the yield of the crop became much lower than the normal (appendix). Late precipitation is not infrequent in this region. If wheat is grown as relay crop disease stress will be a common problem. This assumption encouraged the research to conduct further experiment for the control of the seedling blight/ leaf spot/leaf blotch disease.

CHAPTER-II

INTRODUCTION

CHAPTER II

CONTROL OF LEAF BLOTCH ORGANISM *BIPOLARIS SOROKINIANA* BY BIOCIDES

INTRODUCTION

Wheat (*Triticum aestivum*) is the world leading cereal crop and ranked second in Bangladesh. A number of causes namely late precipitation, weed infestation, high temperature, and disease severity are associated for the reduction of wheat yield in rice-wheat relay cropping system. Among the stresses disease one of the most important causes for the reduction of wheat yield.

Among the diseases spot blotch caused by *Bipolaris srokiniana* (Sacc. in Sork) Shoem, teleomorph *Cochliobolus sativus* is now the most destructive disease of wheat in the rice-based cropping system of Bangladesh (Anynomous, 1998). Almost all released varieties showed varying degrees of spot blotch susceptibility. From a number of experiments over years the average yield loss was estimated as 15%. (Alam *et al.*, 1998). The fungus also causes seedling blight, root rot, leaf spot and black point disease of wheat.

Farmers are using chemical fungicides indiscriminately in large scale for the control of this fungus *B. sorokiniana*, which are extremely harmful for human health and degrading the ecological balance. Moreover most of the chemicals are costly so the farmers have to spend a large amount to purchase these chemicals. Now-a-days use of chemical for management of crop disease is being discouraged due to health hazards and environmental pollution. In this context, use of environment friendly biocides may be an alternative for controlling plant diseases.

Efficacy of plant extracts for controlling seed-borne pathogens has been reported by Alice and Rao (1987), Suratuzzaman *et al.* (1994), Fakir and Khan (1992) and by other scientists at home and abroad. Different types of plant and plant products have been reported to control of plant pathogenic fungi in the field, (Bowers *et al.*,

2000; Lawson *et al.*, 1998). Botanical extracts are biodegradable (Devlin and Zettel, 1999) and their use in crop protection is a practical sustainable alternative. It reduces environmental contamination and health hazards (Grange and Ahmed, 1988). Research on the active ingredients, fungicide preparation, application rates and environmental impact of botanical fungicides is a prerequisite (Buss and Park, 2002) for sustainable agriculture. Botanical fungicides are unique because they can be produced easily by the farmers and small industries (Roy *et al.*, 2005). Few works have been done by using tobacco, neem garlic and some other plant extracts to control some other fungi. Antifungal activities of garlic, neem, and allamanda have been reported by many workers (Islam, 2005; Rahman *et al.*, 1999; Khan, 1999; Arun *et al.*, 1995; Mohanty *et al.*, 1995; Mahmud *et al.*, 2007).

Some farmers of Dakope Upazila of Khulna District have been using effectively extracts of tobacco and banyan leaf in cow's urine against insects and diseases instead of chemical pesticides (Nandi, 2007)

So, it is thus dire necessity to work extensively to examine the effect of different concentration of tobacco, neem, garlic and other indigenous plant extract and biocides like ginger, turmeric, cow's urine etc. in controlling disease which caused by different fungi.

In consideration of the above circumstances, the present experiment was conducted with the following objectives-

1. To find out the effective concentration of different biocides as fungicidal materials.
2. To evaluate the effectivity of cow's urine as itself or as solvent.

MATERIALS AND METHODS

MATERIALS AND METHODS

The experiment was conducted in the Plant Protection Laboratory of Agrotechnology Discipline, Khulna University, Khulna to evaluate the effect of extracts of 9 plants namely rhizome of turmeric, rhizome of ginger, garlic bulb, neem leaf, nishindha leaf, tobacco leaf, datura leaf, marigold leaf, banyan leaf and cow's urine at different concentrations (20%, 30%, 40%, 50%, 60%, and 70%) on the growth and sporulation of *B. sorokiniana*, causal agent of leaf blotch disease of wheat during the period from January 2007 to June 2007. In this experiment the crude extracts of the above indigenous plants and cow's urine along with the crude extract of those selected indigenous plants were prepared and mixed with Potato Dextrose Agar (PDA) medium at different concentrations and the fungal mycelia were inoculated to grow. Data on the radial growth and number of spores per petridish were recorded.

Collection of the disease samples

Disease samples of wheat leaf blight (*Bipolaris sorokiniana*) were collected from the previous experiment.

Isolation of the fungus

The fungus was isolated following standard procedures (Dhingra and Sinclair, 1985).

Preparation of Water Agar (WA) and Potato Dextrose Agar (PDA)

For the preparation of water agar 1000 ml water was take in a beaker and was placed in a hot water bath and then 15 g agar were mixed in hot water. The mixture was stirred with the help of a glass rod until the agar was fully melted then the volume was adjusted to 1000ml with distilled water. The basic medium, Potato Dextrose Agar (PDA) was prepared following the standard procedure (Anonymous, 1968).

Purification and preservation

PDA was poured in sterilized petridishes, 20 ml in each. To obtained pure culture of *Bipolaris sorokininia*, a hyphal tip was transferred aseptically from the water agar plate onto PDA plate by using a fine sterilized needle. Then the plate was sealed with the parafilm to avoid contamination and then incubated at room temterature of 28 ± 2^0 C for 54 hours. White mycelial colony was produced. Advanced hyphae were transferred aseptically and transferred into the test tube slants containing PDA of pH 6.5 and incubated at room temperature of 28 ± 2^0 C for 54 hours. After incubation, these slants were carefully checked for contamination and then preserved at 4^0C in a refrigerator for further use. All the works were undertaken under the laminar air flow.

Identification of the fungal isolates

Fungal isolate was identified on the characteristics of hyphae and spore (*Bipolaris*) with the help of stereo- microscope following standard procedure.

Preparation of botanical extracts

Botanical extracts were prepared by using a newly adapted method following the standard procedure (Vijayalakshmi *et al.*, 1999)

Materials required

Materials used in this experiment are listed in the following table. In all cases same concentrations were used and that is 20%, 30%, 40%, 50%, 60% and 70%.

Table 1. The parts of the plants and animal used in the experiment.

Name of plants/animal	Scientific name	Family	Biocides/plant parts used.
Datura	*Datura metel*	Solanaceae	Leaf
Neem	*Azadirachta indica*	Meliaceae	Leaf
Marigold	*Tagetes erecta*	Compositae	Leaf
Garlic	*Allium sativum*	Alliaceae	Bulb
Ginger	*Zingiber officinale*	Zingiberaceae	Rhizome
Turmeric	*Curcuma longa*	Zingiberaceae	Rhizome
Nishindha	*Vitex negundo*	Verbenaceae	Leaf
Tobacco	*Nicotiana tabacum*	Solanaceae	Leaf
Banyan tree	*Ficus benghalensis*	Ficus	Leaf
Cow	*Boss taurus*	Bovidae	Urine

Preparation of extracts

Ginger rhizome

Rhizomes were collected from the market. Fresh rhizomes of ginger were taken into mortar and pestle. From this pure ginger rhizome extracts was collected. Then 20, 30, 40, 50, 60 and 70 ml pure ginger rhizome extracts were mixed separately with 80, 70, 60, 50, 40 and 30 ml PDA respectively in separate 100 ml conical flask.

Turmeric rhizome

Fresh rhizomes of turmeric were collected from the local area. Rhizomes of turmeric were taken into mortar and pestle and pure extract was collected and media of required concentrations were prepared.

Garlic bulb

Fresh garlic bulbs were collected from the market. Garlic bulbs were taken into mortar and pestle and pure extract was collected and media of required concentrations were prepared.

Neem leaf

Fresh neem leaves were collected directly from the neem tree. The collected neem leaves were washed with tap water and taken into mortar and pestle. From this pure neem leaf extract was collected and media of required concentrations were prepared.

Nishindha leaf

Fresh nishindha leaves were collected from the local area. Nishindha leaves were taken into mortar and pestle and pure extract was collected and media of required concentrations were prepared.

Datura leaf

Fresh datura leaves were collected from the local area. Datura leaves were taken into mortar and pestle and pure extract was collected and media of required concentrations were prepared.

Marigold leaf

Fresh marigold leaves were collected from the local area. Marigold leaves were taken into mortar and pestle and pure extract was collected and media of required concentrations were prepared.

Tobacco leaf in water

300 ml of water was taken into a 1000 ml beaker by using measuring cylinder and 300 g of tobacco crude leaf was soaked in it for 24 hours. After pressing by hand the crude extract was filtered and collected. The crude extract was diluted to required concentrations

Banyan leaf in water

300 ml of water was taken into a 1000 ml beaker. 300 g of banyan leaf was soaked in it for 7 days. After pressing by hand the crude extract was filtered and collected. The crude extract was diluted to required concentrations.

Tobacco leaf in cow's urine

300 ml of cow's urine was taken into a 1000 ml beaker. 300 g of tobacco leaf was soaked in it for 24 hours. After pressing by hand the crude extract was filtered and collected. The crude extract was diluted to required concentrations.

Banyan leaf in cow's urine

300 ml of cow's urine was taken into a 1000 ml beaker. 300 g of banyan leaf was soaked in it for 7 days. After pressing by hand the crude extract was filtered and collected. The crude extract was diluted to required concentrations.

Banyan leaf and tobacco leaf in cow's urine for 24 hours

300 ml of cow's urine was taken into a 1000 ml beaker. 300 g of banyan leaf and 300 g of tobacco leaf was soaked in it for 24 hours. After pressing by hand the crude extract was filtered and collected. The crude extract was diluted to required concentrations.

Banyan leaf and tobacco leaf in cow's urine for 7 days

300 ml of cow's urine was taken into a 1000 ml beaker. 300 g of banyan leaf and 300 g of tobacco leaf was soaked in it for 7 days. After pressing by hand the crude extract was filtered and collected. The crude extract was diluted to required concentrations

Cow's urine

Fresh cow's urine was collected from the local area. It was diluted into required concentrations.

Treatments

The effect of different plant extracts and cow's urine namely turmeric, ginger, garlic, neem, nishindha, marigold, datura, cows urine, tobacco leaf in water (soaked tobacco leaf in water for 24 hours), banyan leaf in water (soaked banyan leaf in water for 7 days), tobacco leaf in cows urine (soaked tobacco leaf in cows urine for 24 hours), banyan leaf in cows urine (soaked banyan leaf in cows urine for 7 days), banyan leaf and tobacco leaf in cows urine (both tobacco leaf and banyan leaf soaked in cows urine for 24 hours) and banyan leaf plus tobacco leaf in cows urine (both the tobacco leaf and banyan leaf were soaked in cows urine for 7 days) on mycelial growth and sporulation of *Bipolaris sorokiniana* were determined. The basic PDA medium was modified by using different crude extracts and cow's urine at specified concentrations. The pH of the medium was adjusted to 6.5. The fungus was grown on plate containing 20 ml of the medium per petridish. Five replicated petridishes were used for each treatment. The plates were inoculated by placing one 5 mm discs of 48 hours old PDA culture at centre. The mycelial discs were taken from the edge of the colony. The plates were incubated at 26 ± 2^{0}C. The radial growths of mycelium and colony characters in each plate were recorded after 7 (seven) days of incubation.

Measurement of radial growth (cm) and determination of percent inhibition

After 7 (seven) days of incubation, radial growth (cm) of *Bipolaris sorokiniana* in petridishes was recorded. The radial growth (cm) of mycelium of each plate was measured by taking average of the two diameters taken right angles for each colony and then these plates were kept for 10 days for spore (*Bipolaris*) formation.

Percent inhibition of growth was calculated using the following formula:

$$\% \text{ Inhibition} = \frac{x-y}{x} \times 100$$

Where, x = Average growth (cm) of *B. sorokiniana* in control petrisishes.

y = Average growth (cm) of *B. sorokiniana* in each plant extract and biocides treated petridishes

Counting of spores (*Bipolaris*)

After 10 days the spores of each petridishes were separated. For the separation of spores firstly 10 ml water was taken into the petridish and then the spores were separated carefully with the help of a spatula so that the PDA media were not mixed to the spores. After separation the spore suspension was diluted in water. The amount of water required for dilution was depended on the number of spore. If the number of spores were much then first dilution was fractioned and then second dilution was fractioned and so on whenever required. For counting spores single drop spore suspension of water from the dilution was taken onto the slide and seen under electronic microscope. This procedure was followed for three times for the same dilution and then the number of spores was recorded by multiplication depending on the amount of dilution. Here a petridish was maintained as control to compare it with others.

Spore produced per petridish = No. of spore per drop of water × 20 × total volume

Experimental design and data analysis

Completely Randomized Design (CRD), with fourteen treatments and seven concentrations with each of five replications was used in this experiment. Data were analyzed by using MSTAT-C program. Data on the number of spores (*Bipolaris*) were subjected to log transformation. The significance difference, if any, among the means were compared by Duncan's Multiple Range Test (DMRT).

RESULTS

RESULTS

The effect of different plant extracts and cow's urine on the mycelial growth and formation of spore of *B. sorokiniana* was presented and discuss in this chapter.

Effect of different plant extracts and cow's urine on mycelial growth of *B. sorokiniana* at different concentrations

The different plant extracts and cow's urine in different concentration inhibited the mycelial growth of *B. Sorokiniana* significantly ($p<0.01$) (Table 2).

Ginger rhizome extracts

The mycelial growth inhibition in different concentration of ginger rhizome extracts was significantly increased with the increase of concentration (Table 2, Pate 1 and Fig. 3). The highest percentage inhibition (56.69%) was observed at 70% concentration and the lowest (34.46%) was found at 20% concentration. Regression equation (Fig. 3) between concentration of ginger rhizome extract and mycelial growth inhibition percentage revealed that almost 100% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Turmeric rhizome extracts

The mycelial growth inhibition in different concentration of turmeric rhizome extracts was significantly increased with the increase of concentration (Table 2, Plate 2 and Fig. 4). The highest percentage inhibition (76.65%) was observed at 70% concentration and the lowest (64.62%) was found at 20% concentration. The percentage inhibition (72.56%) at 60% concentration was statistically similar (71.88%) to 50% concentration. The percent inhibition was statistically similar for the concentration of 40%, 50% and 60% concentration. Regression equation (Fig. 4) between concentration of turmeric rhizome extracts and mycelial growth inhibition percentage revealed that 95% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Garlic bulb extracts

The mycelial growth inhibition in different concentration of garlic bulb extracts was significantly increased with the increase of concentration (Table 2, Plate 3 and Fig. 5). The highest percent inhibition percent (37.18%) was observed at 70% concentration and the lowest percentage inhibition of mycelial growth (14.27%) was observed at 40% concentration. At 30% and 20% concentration mycelial growth were increased 2.34% and 4.06% respectively over control. The mycelial growth significantly differs for each concentration of garlic bulb extracts. Regression equation (Fig. 5) between concentration of garlic bulb extract and mycelial growth inhibition percentage revealed that more than 90% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Neem leaf extracts

The mycelial growth inhibition in different concentration of neem leaf extracts was significantly increased with the increase of concentration (Table 2, Plate 4 and Fig. 6). The highest percent inhibition (29.70%) was observed at 70% concentration and the lowest percent inhibition (17.91%) was found at 20% concentration. The percentage inhibition (25.28%) at 60% concentration was found statistically similar (25.17%) to 50% concentration. Regression equation (Fig. 6) between concentration of neem leaf extract and mycelial growth inhibition percentage revealed that more than 95% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Nishindha leaf extracts

The mycelial growth inhibition in different concentration of nishindha leaf extracts was significantly increased with the increase of concentration (Table 2, Plate 5 and Fig. 7). The highest percent inhibition (66.44%) was observed at 70% concentration and the lowest percent inhibition (31.22%) was found at 40% concentration. Here also mycelial growth increased over control at 30% and 20% of nishindha leaf concentration and was 1.59% and 4.24% respectively.

Regression equation (Fig. 7) between concentration of nishindha leaf extract and mycelial growth inhibition percentage revealed that more than 90% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Datura leaf extracts

The mycelial growth inhibition in different concentration of datura leaf extracts was significantly increased with the increase of concentration (Table 2, Plate 6 and Fig. 8). The highest percent inhibition (29.92%) was observed at 70% concentration and the lowest percent inhibition (9.514%) was found at 20% concentration. Regression equation (Fig. 8) between concentration of datura leaf extract and mycelial growth inhibition percentage revealed that more than 95% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Marigold leaf extracts

The mycelial growth inhibition in different concentration of marigold leaf extracts was significantly increased with the increase of concentration (Table 2, Plate 7 and Fig. 9). The highest percent inhibition (31.74%) was observed at 70% concentration and the lowest percent inhibition (8.33%) was observed at 30% concentration. In 20% concentration of the same extract mycelial growth increased 5.78%. Regression equation (Fig. 9) between concentration of marigold leaf extract and mycelial growth inhibition percentage revealed that 95% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Tobacco leaf in water

The mycelial growth inhibition in different concentration of water and tobacco leaf extracts was significantly increased with the increase of concentration (Table 2, Plate 8 and Fig 10). The highest percent inhibition (48.07%) was observed at 70% concentration and the lowest percent of inhibition of mycelial growth

(15.64%) was found at 20% concentration. Regression equation (Fig. 10) between concentration of tobacco leaf in water and mycelial inhibition percentage revealed that more than 85% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Banyan leaf in water

The mycelial growth inhibition due to banyan leaf extracts in water was significantly increased starting from a concentration 0f 50% (12.24) with the increase of concentration (Table 2, Plate 9 and Fig. 11). The highest percent inhibition (18.36%) was observed at 70% concentration and the lowest percent inhibition of mycelial growth (12.24%) was found at 50% concentration. Here also the mycelial growth increased over control at 40%, 30% and 20% concentration of banyan leaf in water and were 2.57, 5.53 and 11.04 respectively. Regression equation (Fig. 11) between concentration of banyan leaf in water and mycelial growth inhibition percentage revealed that more than 90% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Tobacco leaf in cow's urine

The extracts of tobacco leaf soaked in cows urine also tested against *B. sorokiniana*. The extracts caused significant growth inhibitors of the fungus and inhibition was increased with the increase of concentration (Table 2, Plate 10 and Fig. 12). The highest percent inhibition (100%) was observed at 70% concentration and the lowest percent inhibition (59.63%) was observed at 20% concentration. The percentage inhibition (90.02%) at 60% concentration was statistically similar (88.66) to 50% concentration. Regression equation (Fig. 12) between concentration of tobacco leaf in cow's urine and mycelial growth inhibition percentage revealed that 90% of the variation in inhibition percentage could be explained by the increase of concentration.

Banyan leaf in cow's urine

The mycelial growth inhibition of *B. sorokiniana* in different concentration of banyan leaf extracts in cows urine was significantly increased with the increase of concentration (Table 2, Plate 11 and Fig. 13). The highest percent inhibition (86.85%) was observed at 70% concentration and the lowest percent of inhibition of mycelial growth (47.42%) was measured at 20% concentration. Regression equation (Fig. 13) between concentration of banyan leaf in cow's urine and mycelial growth inhibition percentage revealed that more than 95% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Tobacco leaf and banyan leaf in cow's urine for 24 hours

The mycelial growth inhibition in different concentration of tobacco leaf and banyan leaf in cow's urine was significantly increased with the increase of concentration (Table 2, Plate 12 and Fig. 14). The highest percentage (100%) was observed at 70% concentration and the lowest percent of inhibition of mycelial growth (40.36%) was at 20% concentration. Regression equation (Fig. 14) between concentration of tobacco leaf and banyan leaf in cow's urine and mycelial growth inhibition percentage revealed that more than 80% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Tobacco leaf and banyan leaf in cow's urine for 7 days

The mycelial growth inhibition in different tobacco leaf and banyan leaf in cow's urine was significantly increased with the increase of concentration (Table 2, Plate 13 and Fig. 15). The highest percent inhibition (100%) was observed at 70% concentration which was statistically similar to 60% and 50% concentration where inhibition percentage of mycelial growth was (100%) and the lowest percentage inhibition (55.33%) was at 20% concentration. Regression equation (Fig. 15) between concentration of tobacco leaf and banyan leaf and mycelial growth

inhibition percentage revealed that more than 85% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Cow's urine

The mycelial growth inhibition in different concentration of cow's urine was significantly increased with the increase of concentration (Table 2, Plate 14 and Fig. 16). The highest percentage inhibition (100%) was observed at 70% concentration and the lowest percentage inhibition (51.48%) was at 20% concentration. Regression equation (Fig. 16) between concentration of cow's urine and mycelial growth inhibition percentage revealed that more than 80% of the variation in increased inhibition percentage could be explained by the increase of concentration.

Table 2. Effect of the different plant extract and cows urine at different concentration on mycelial growth inhibition of *Bipolaris sorokiniana* over control.

Plant extract and biocide	Inhibition percentage at different concentration					
	20%	30%	40%	50%	60%	70%
Ginger rhizome	34.46 f	40.13 e	44.44 d	49.88 c	53.51 b	56.69 a
Turmeric rhizome	64.62 e	68.26 d	70.12 c	71.88 bc	72.56 b	76.65 a
Garlic bulb	-4.064 f	-2.340 e	14.27 d	27.42 c	30.87 b	37.18 a
Neem leaf	17.91 e	20.40 d	22.68 c	25.17 b	25.85 b	29.70 a
Nishindha leaf	-4.242 f	-1.594 e	31.22 d	51.69 c	62.13 b	66.44 a
Datura leaf	9.5 14 f	13.15 e	17.46 d	19.49 c	24.95 b	29.92 a
Marigold leaf	-5.776 f	8.330 e	9.968 d	21.98 c	25.62 b	31.74 a
Tobacco in water	15.64 e	17.23 e	18.59 d	25.07 c	43.95 b	48.07a
Banyan leaf in water	-11.04 f	-6.530e	-2.572d	12.24 c	15.64 b	18.36 a
Tobacco in cows urine	59.63 e	69.62 d	86.62 c	88.66 b	90.02 b	100.0 a
Banyan leaf in cows urine	47.42 f	53.28 e	62.36 d	67.58 c	73.92 b	86.85a
Tobacco leaf and Banyan leaf in cows urine for 24 hours	40.36 f	47.79 e	52.15 d	55.09 c	67.58 b	100.0 a
Tobacco and Banyan leaf in cows urine for 7days	55.33 d	63.62 c	81.17 b	100.0 a	100.0 a	100.0 a
Cows urine	51.48 f	70.07 e	73.69 d	86.17 c	95.01 b	100.0 a
CV (%)	2.91					

Figure in the row with similar letters do not differ significantly at 1% level.

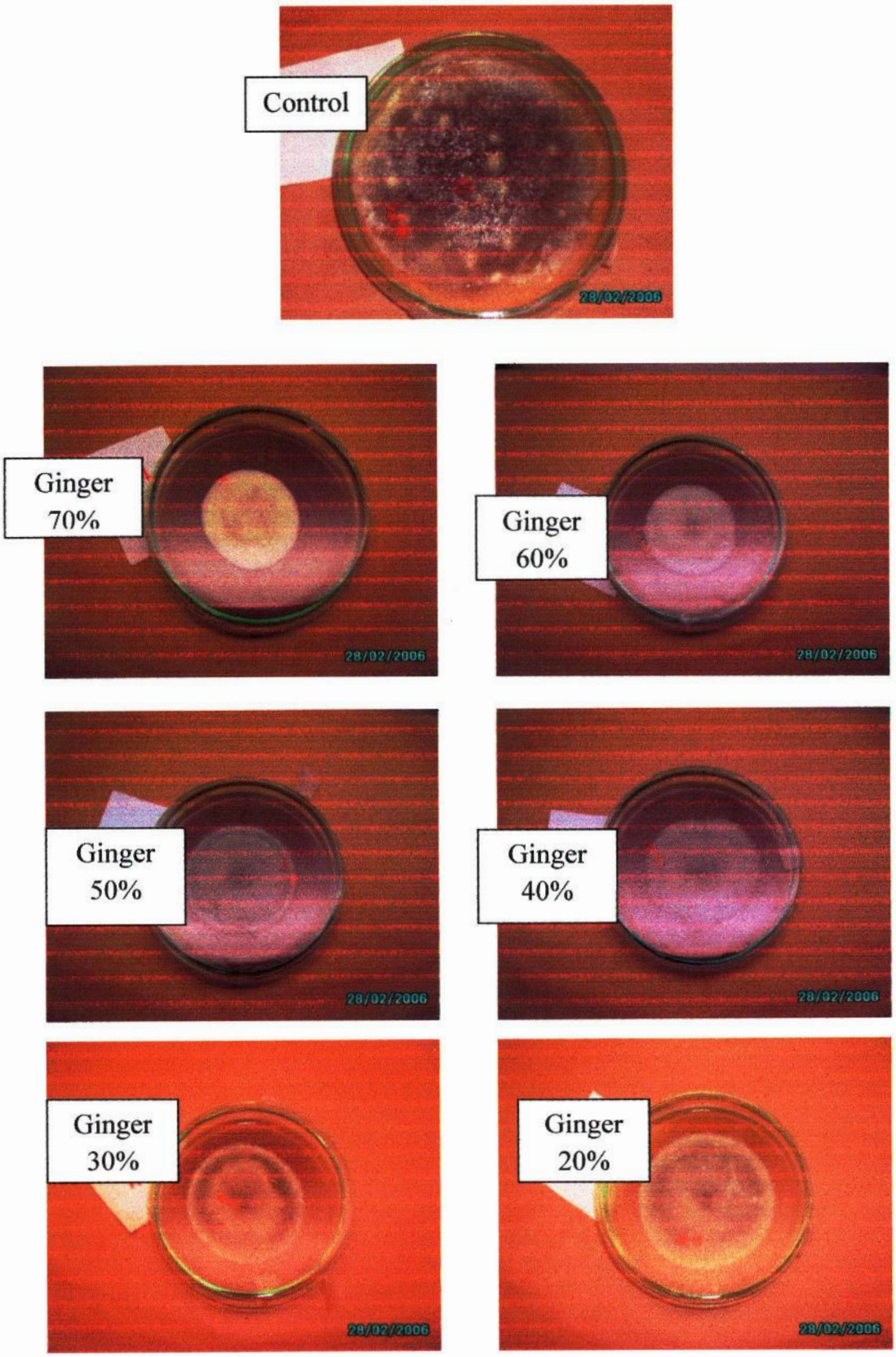

Plate 1. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of ginger rhizome extracts as compared to control

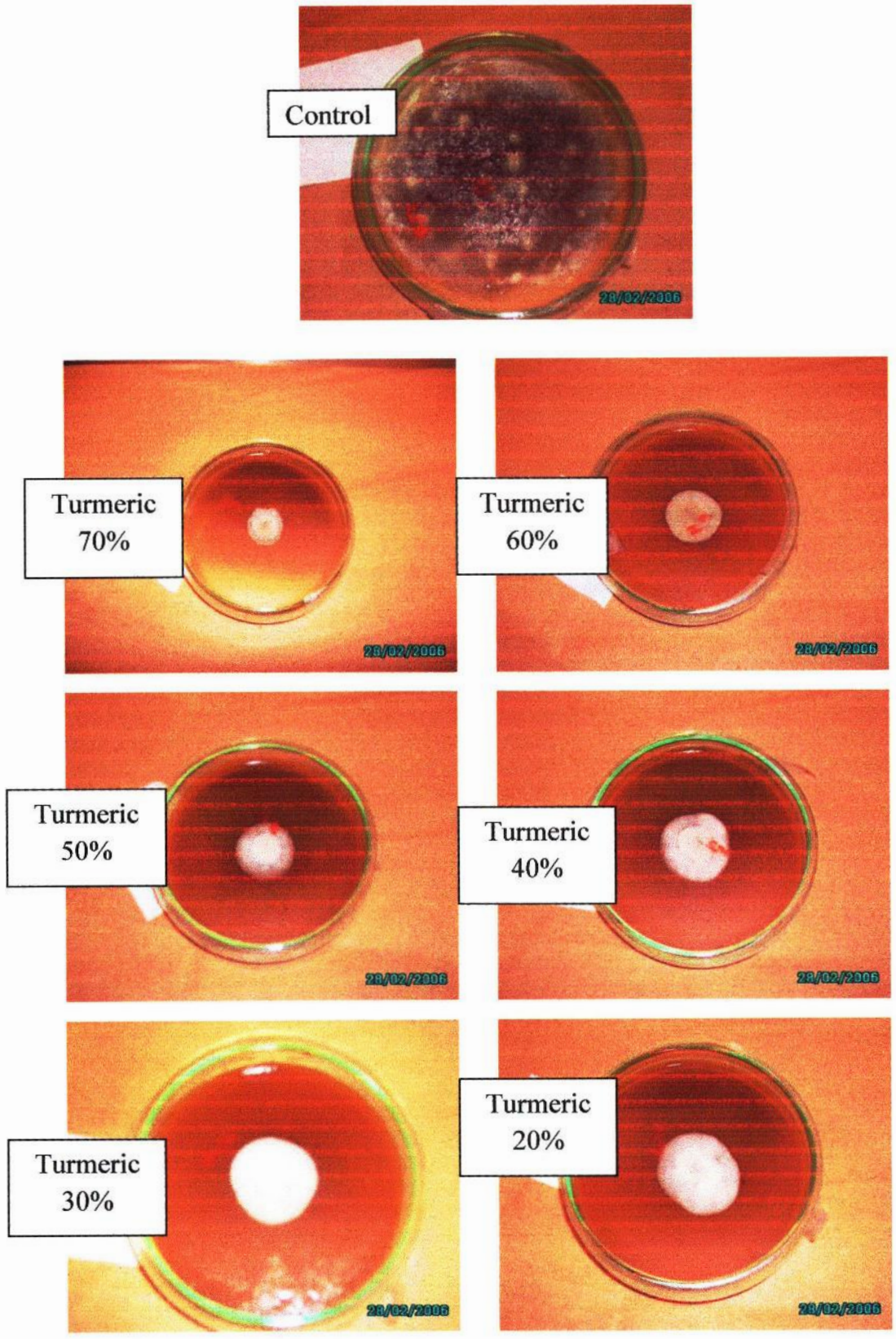

Plate 2. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of turmeric rhizome extracts as compared to control

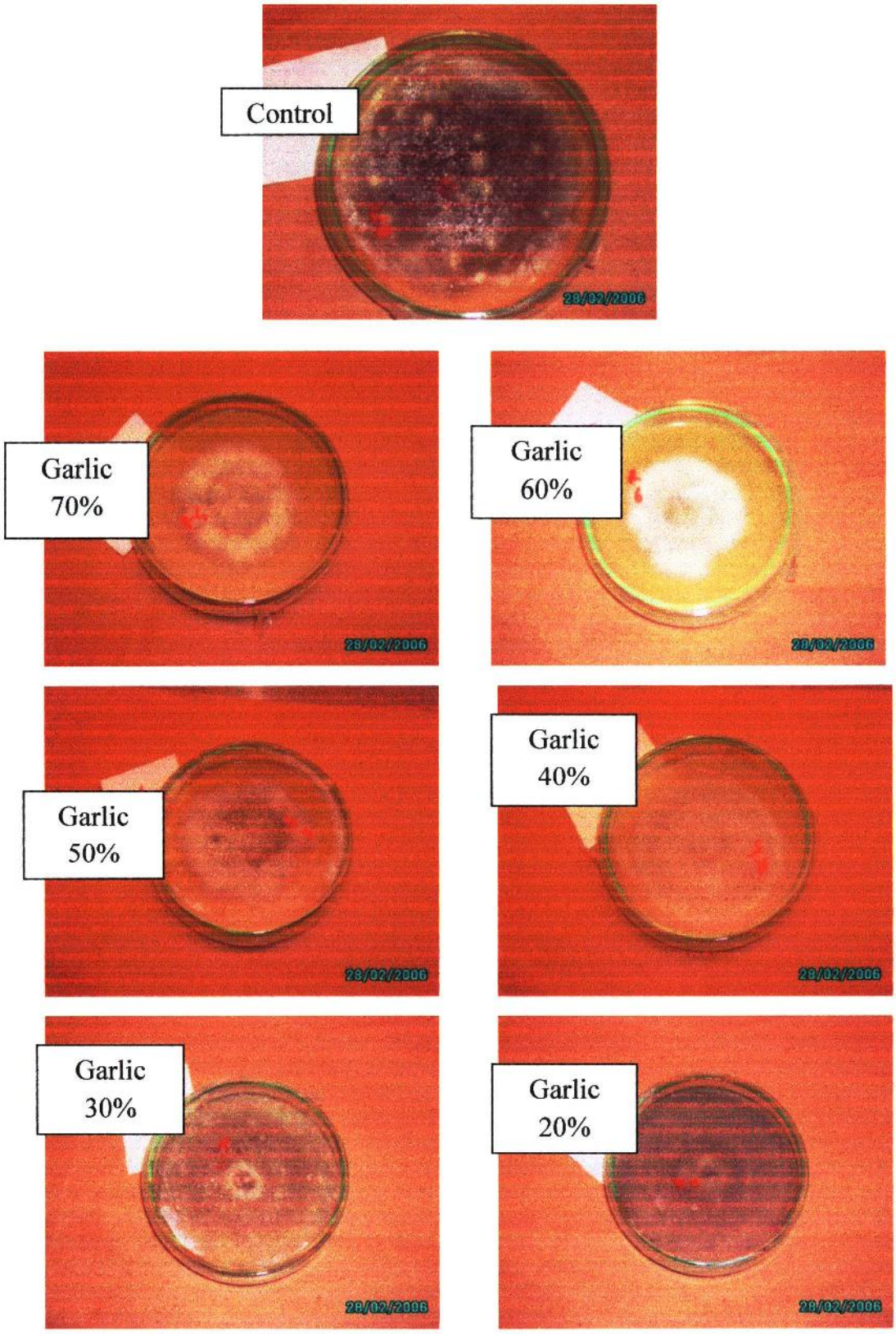

Plate 3. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of garlic bulb extracts as compared to control

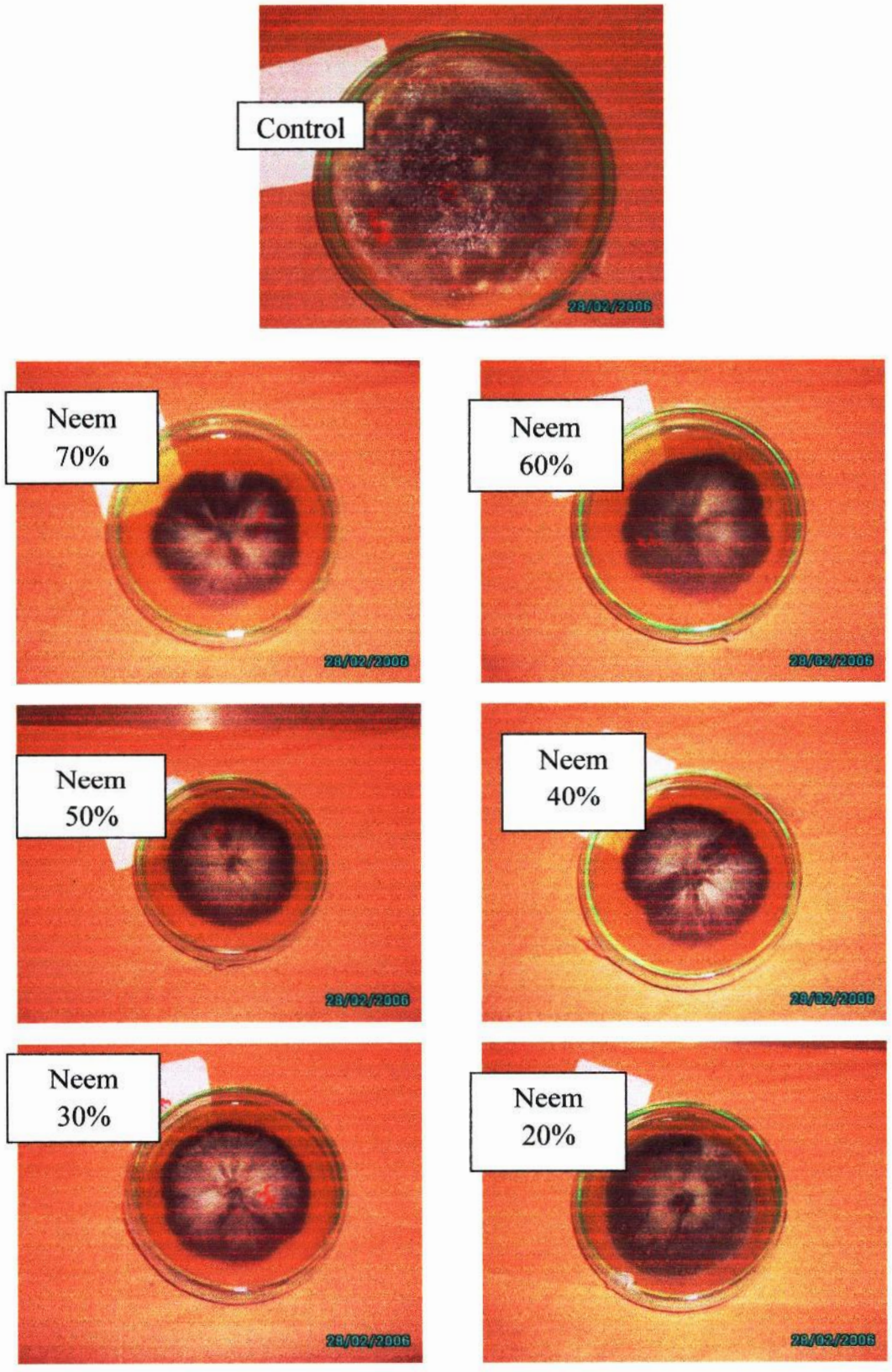

Plate 4. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of neem leaf extracts as compared to control

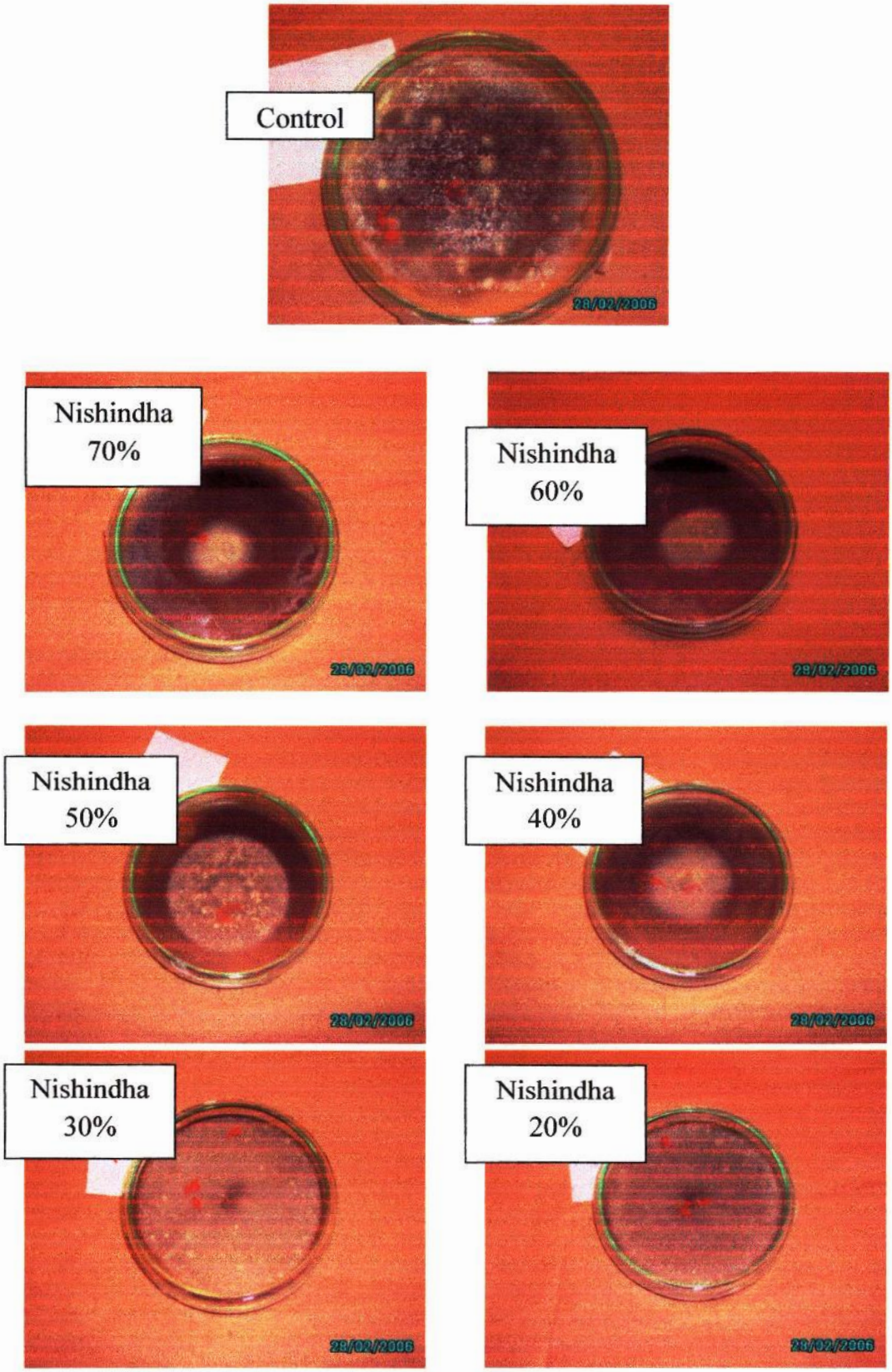

Plate 5. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of nishindha leaf extracts as compared to control

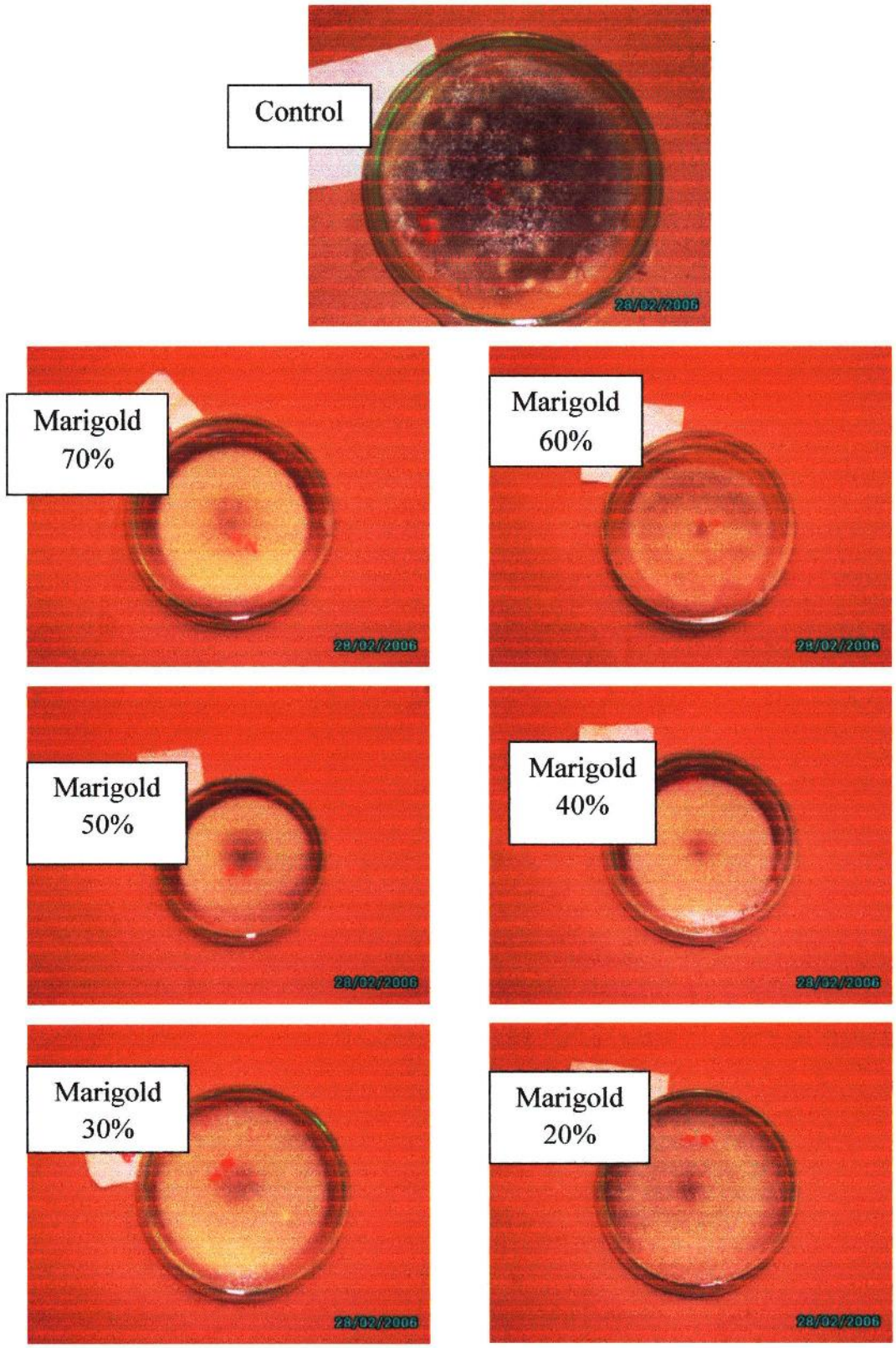

Plate 7. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of marigold leaf extracts as compared to control

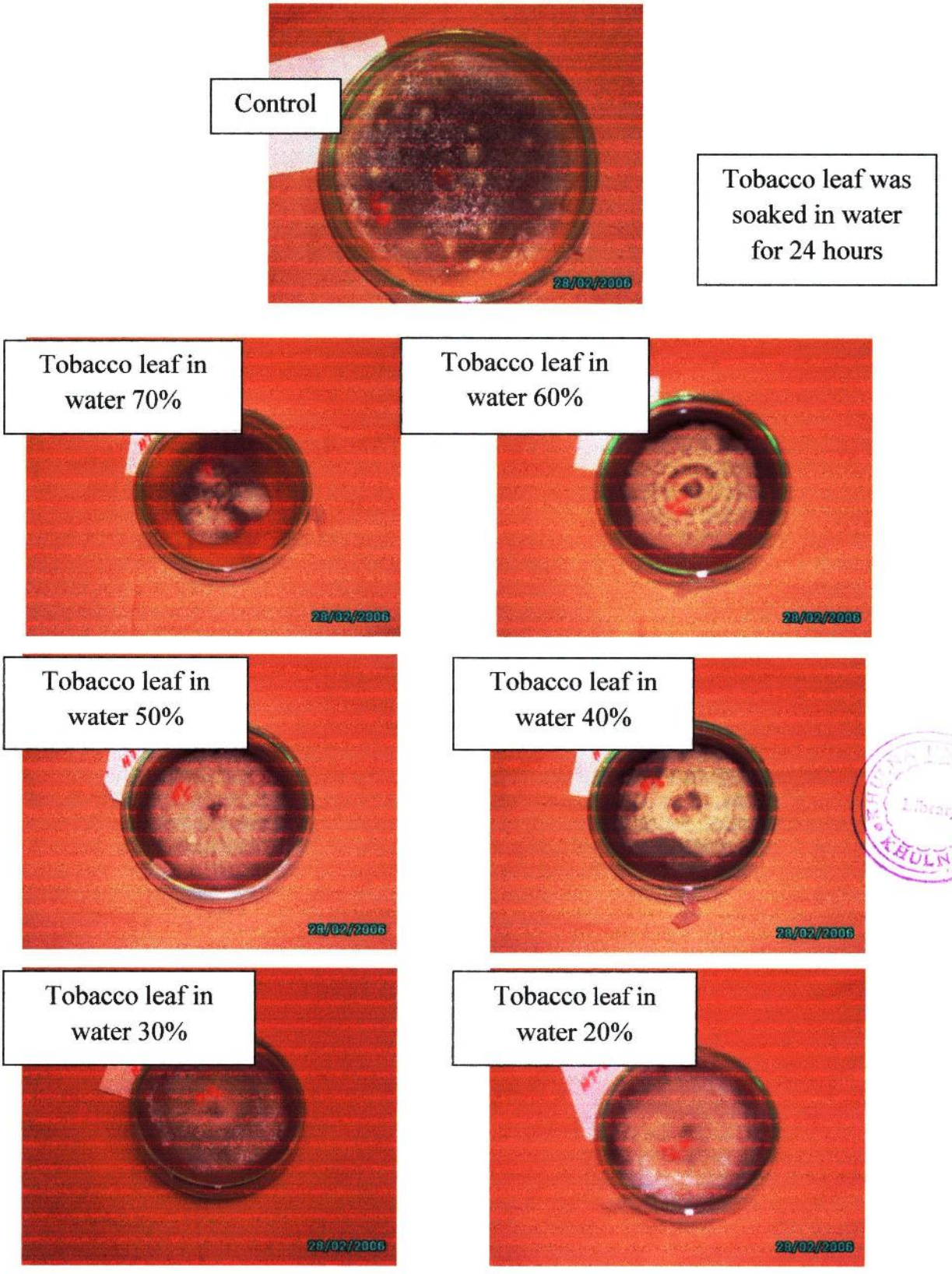

Plate 8. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of tobacco leaf in water as compared to control

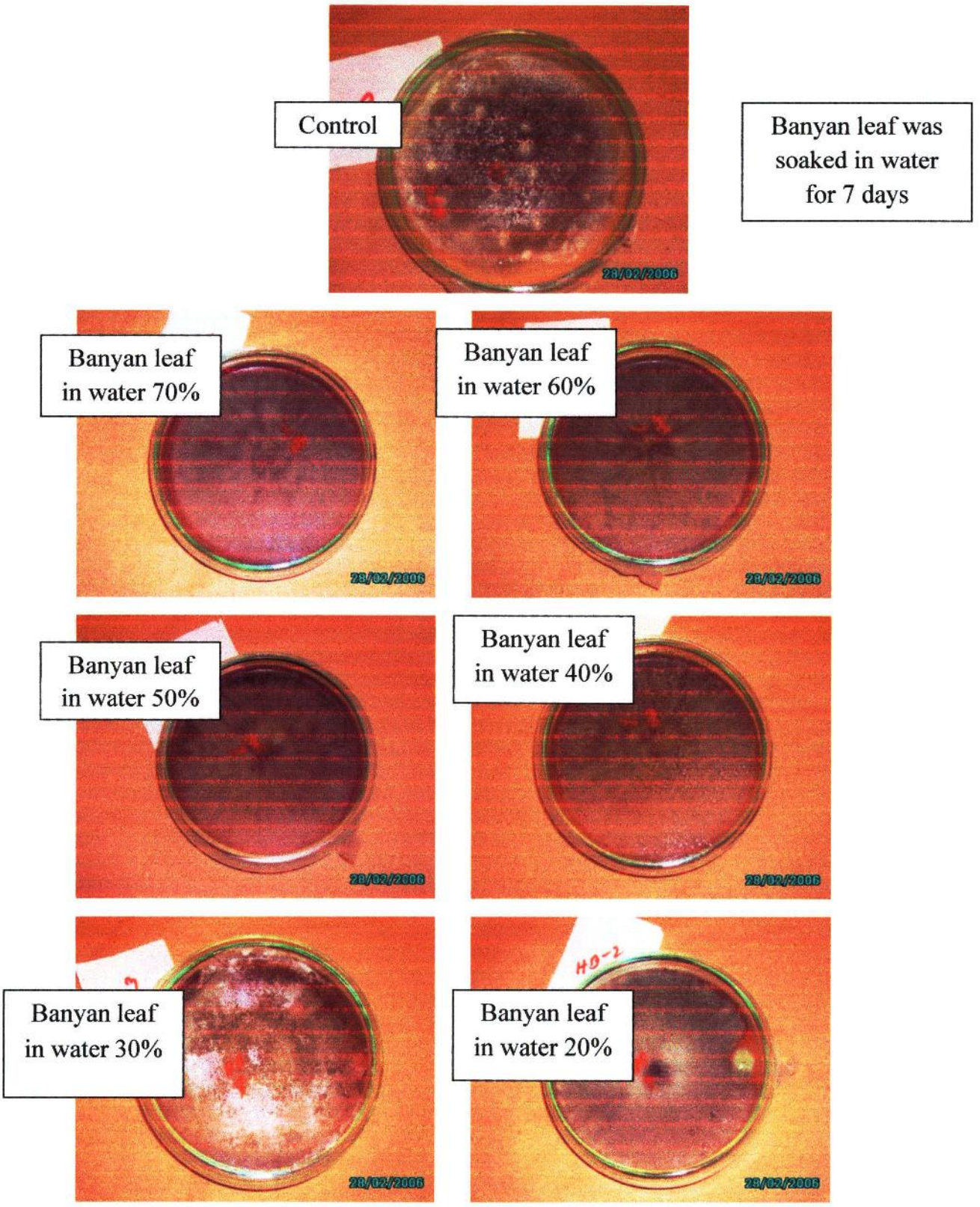

Plate 9. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of banyan leaf in water as compared to control

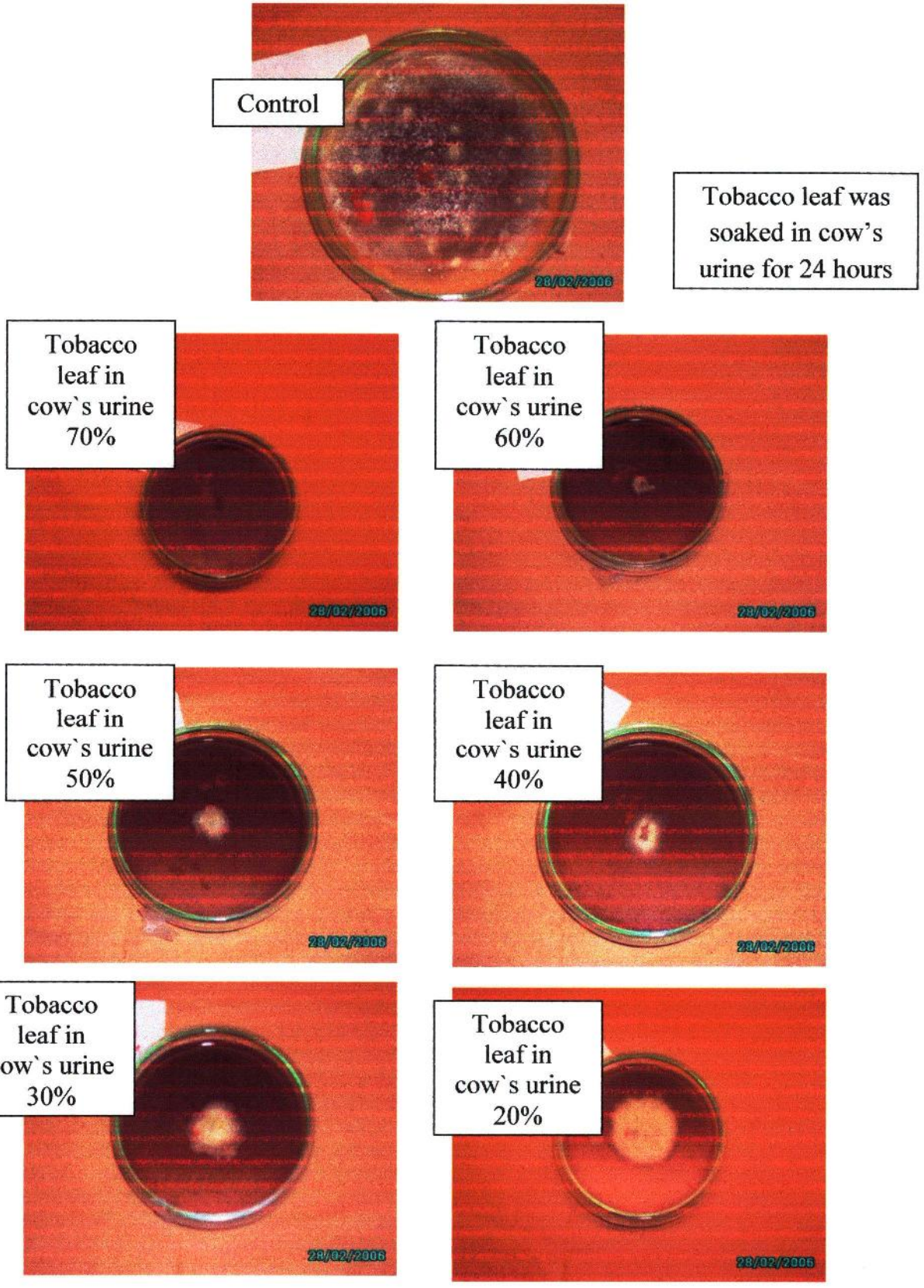

Plate 10. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of tobacco leaf in cows urine as compared to control

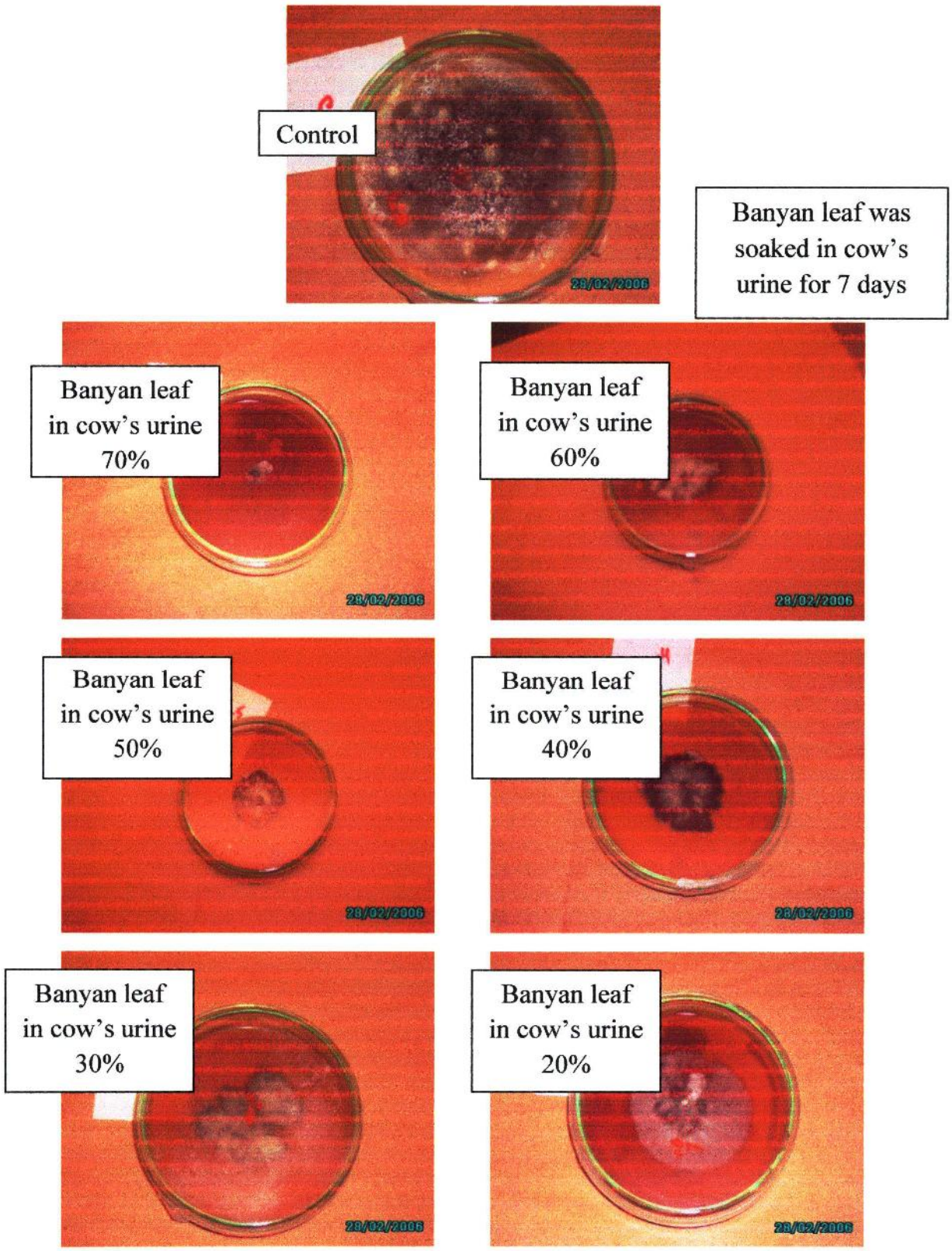

Plate 11. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of banyan leaf in cows urine as compared to control

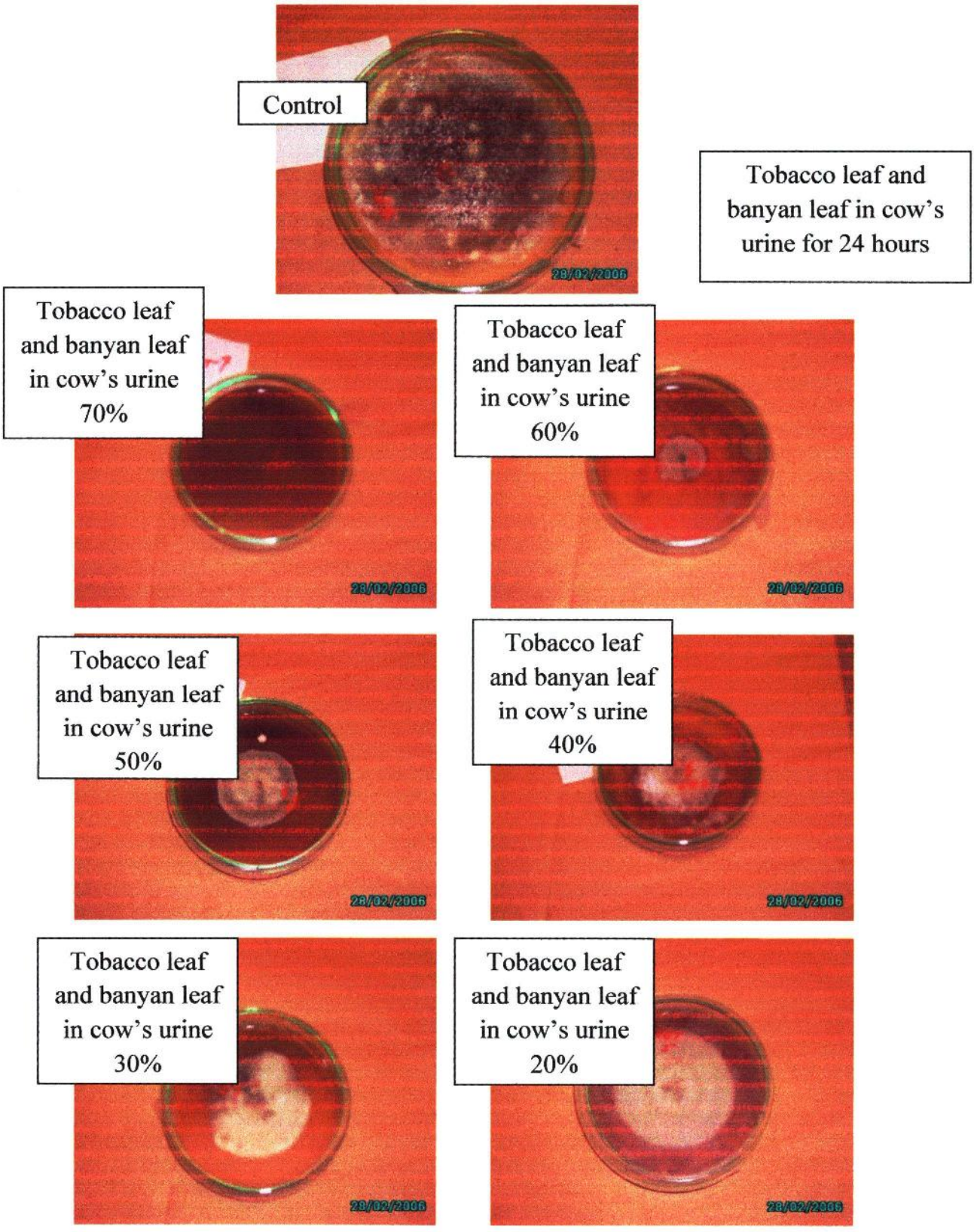

Plate 12. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of tobacco leaf and banyan leaf in cows urine for 24 hours as compared to control

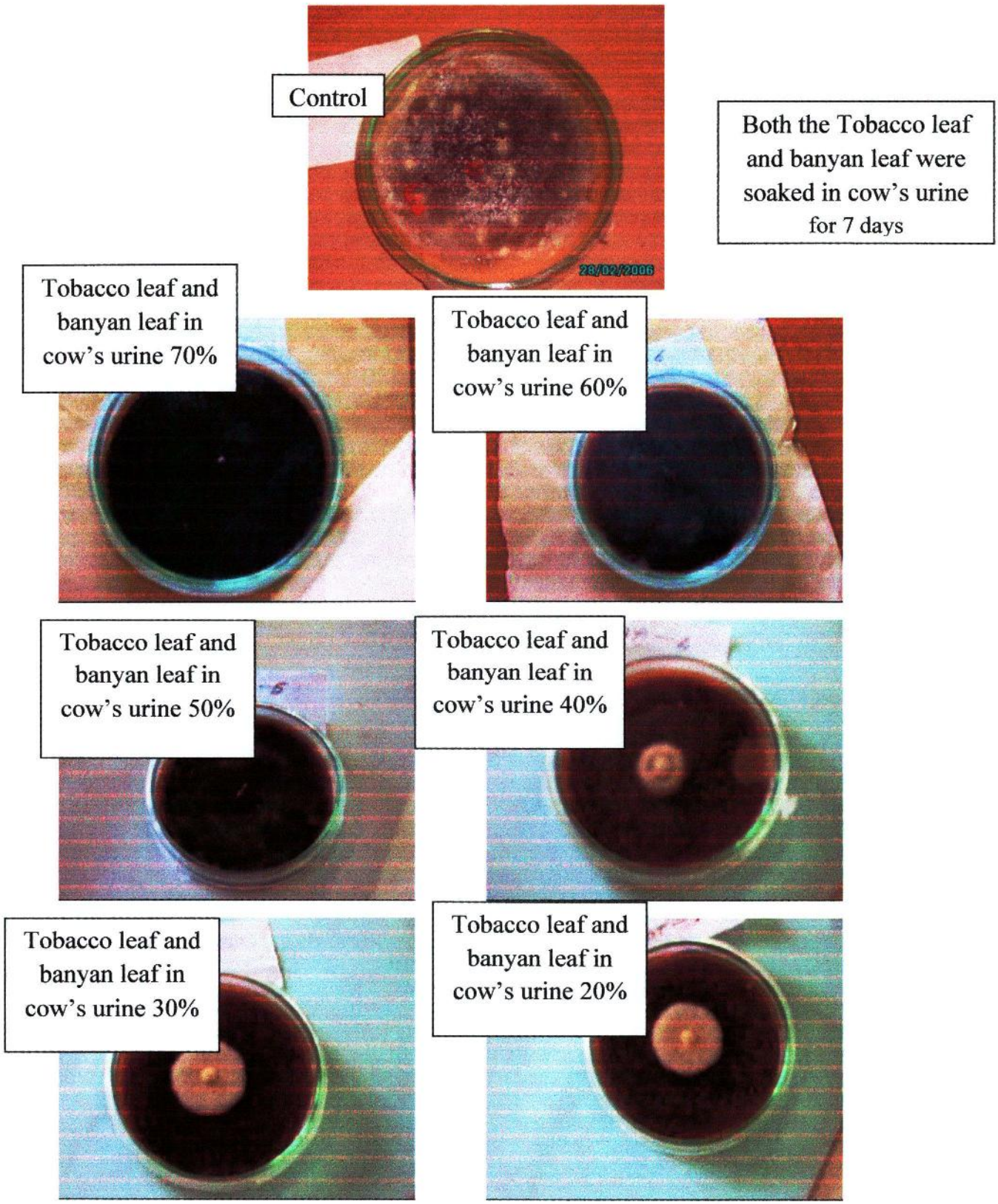

Plate 13. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of tobacco leaf and banyan leaf in cows urine 7 days as campared to control

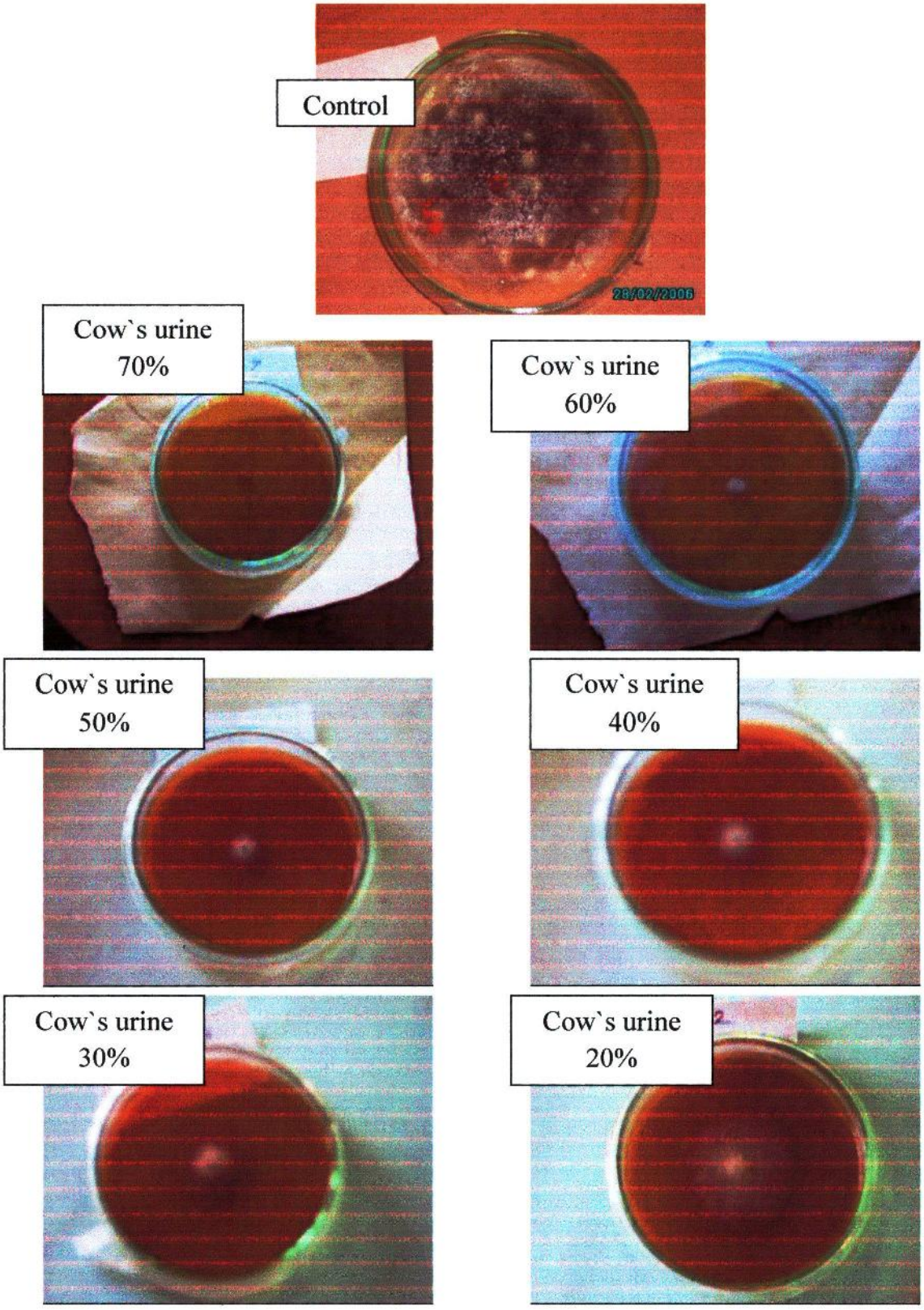

Plate 14. Mycelial growth of *Bipolaris sorokiniana* at different concentrations of cows urine as compared to control

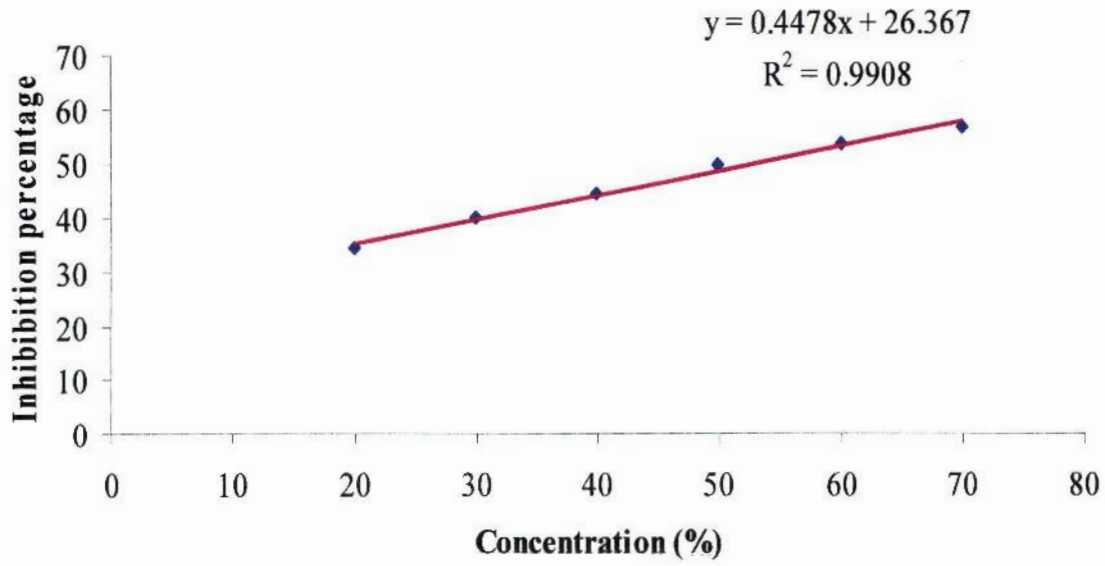

Fig. 3. Functional relationship between concentration and mycelial growth inhibition percentage on ginger rhizome extract.

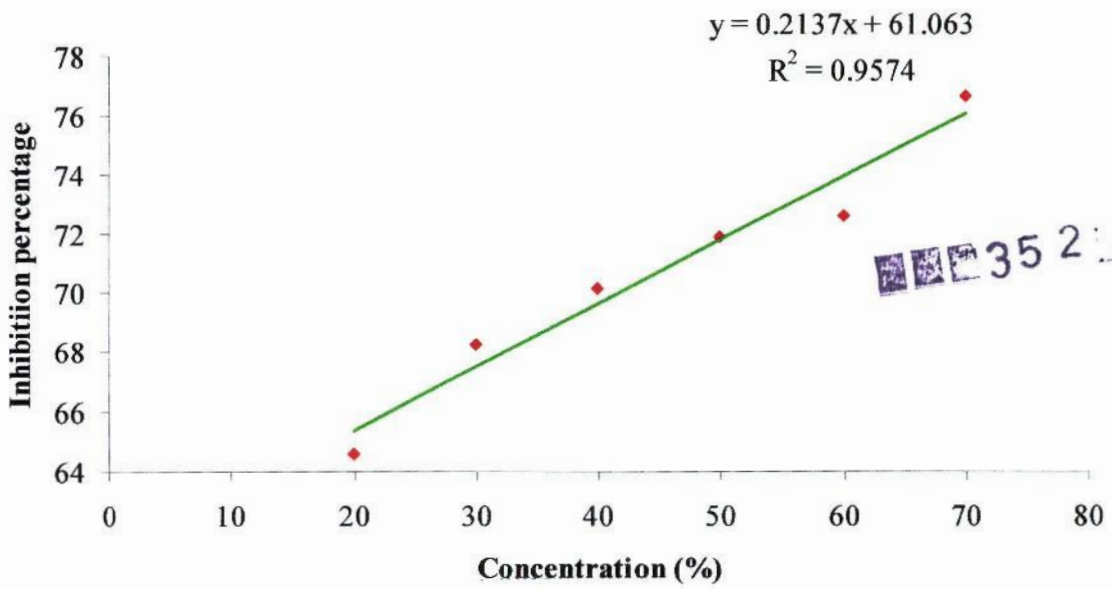

Fig. 4. Functional relationship between concentration and mycelial growth inhibition percentage on turmeric rhizome extract.

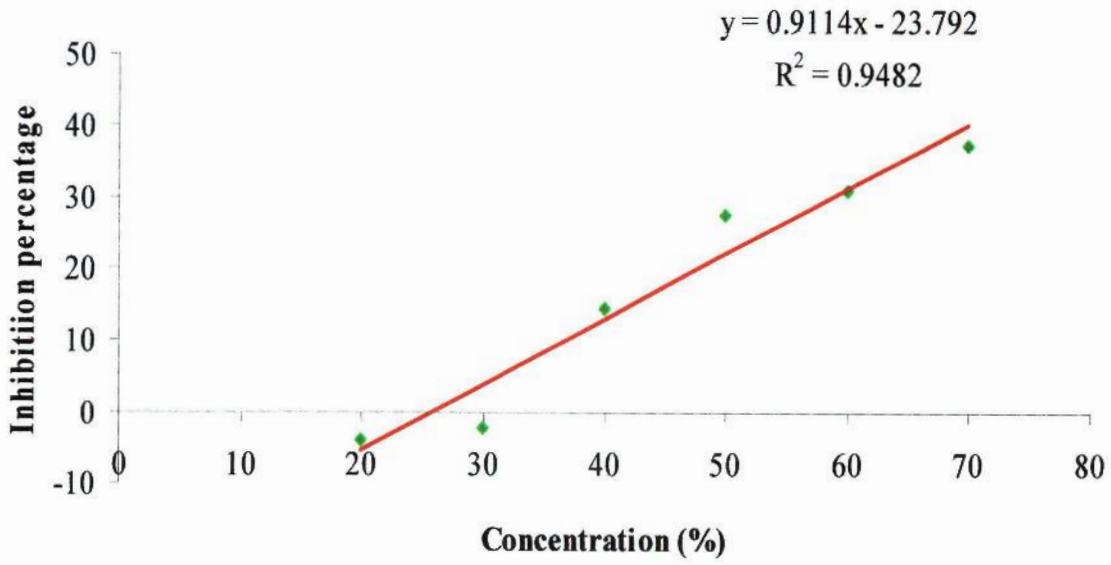

Fig. 5. Functional relationship between concentration and mycelial growth inhibition percentage on garlic bulb extract.

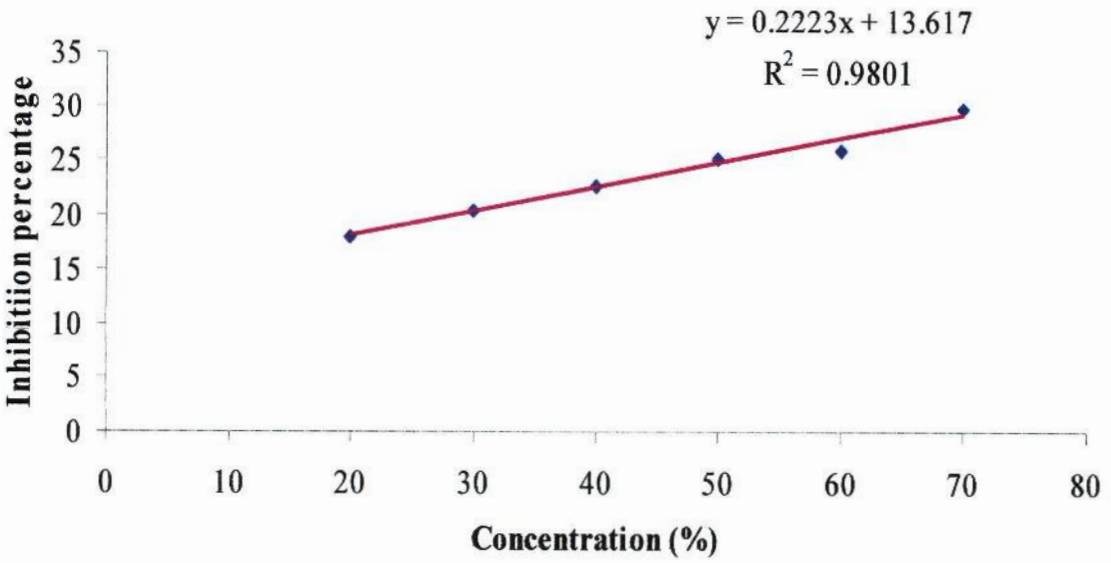

Fig. 6. Functional relationship between concentration and mycelial growth inhibition percentage on neem leaf extract.

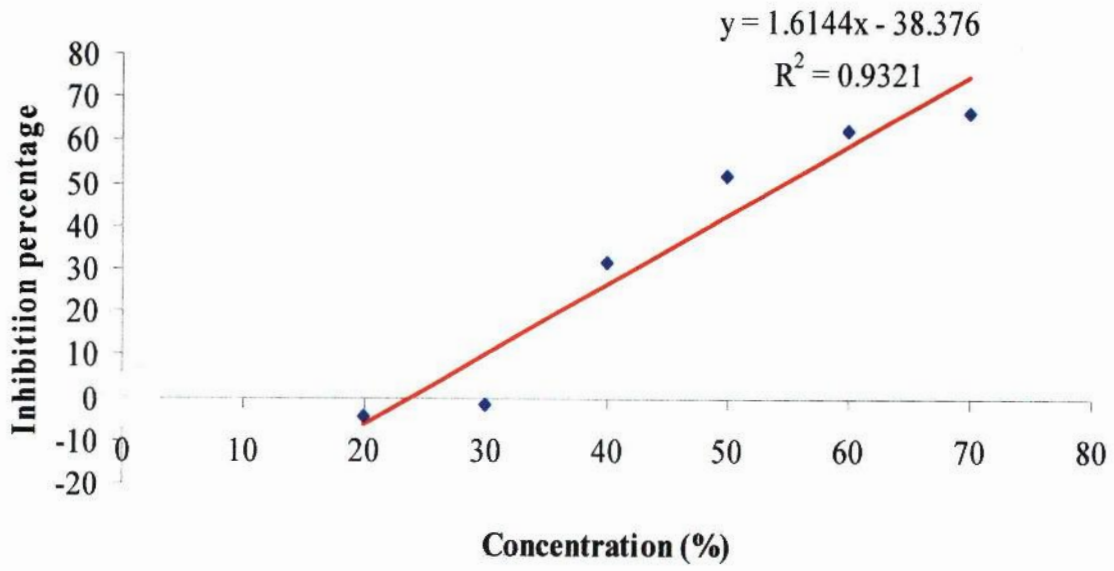

Fig. 7. Functional Relationship between concentration and mycelial growth inhibition percentage on nishindha leaf extract.

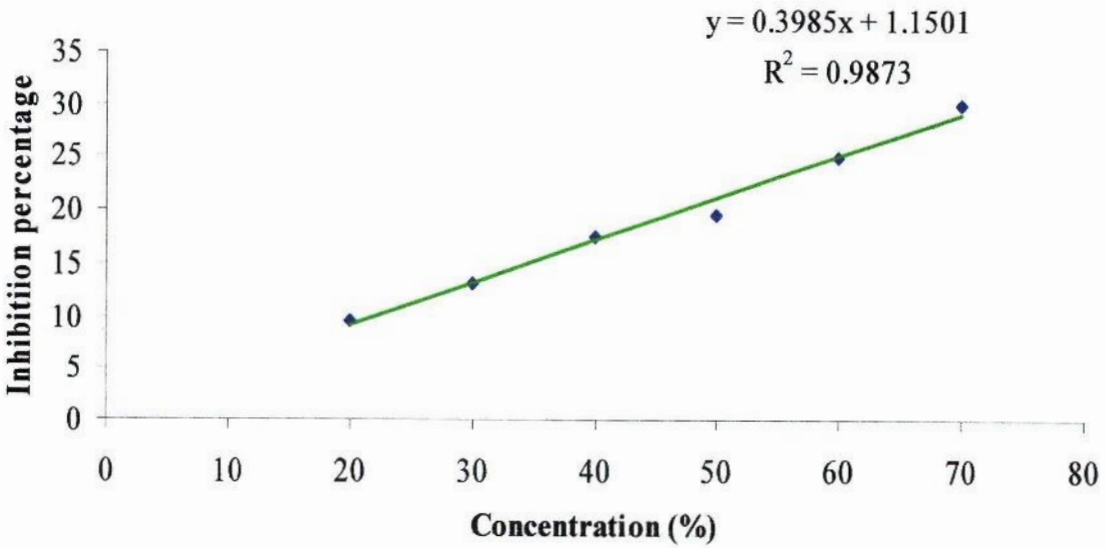

Fig. 8. Functional relationship between concentration and mycelial growth inhibition percentage on datura leaf extract.

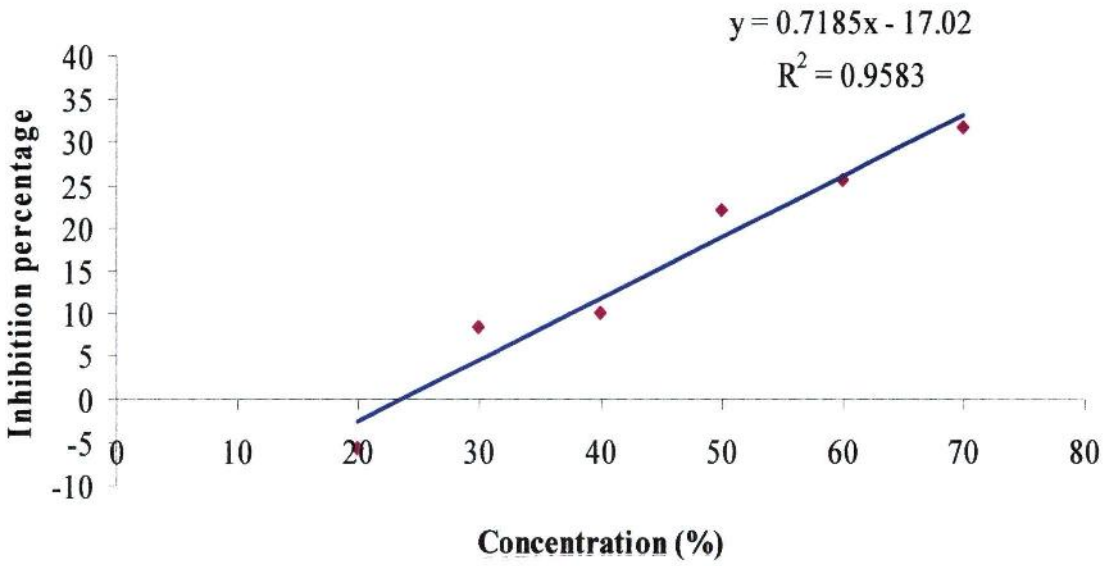

Fig. 9. Functional relationship between concentration and mycelial growth inhibition percentage on marigold leaf extract.

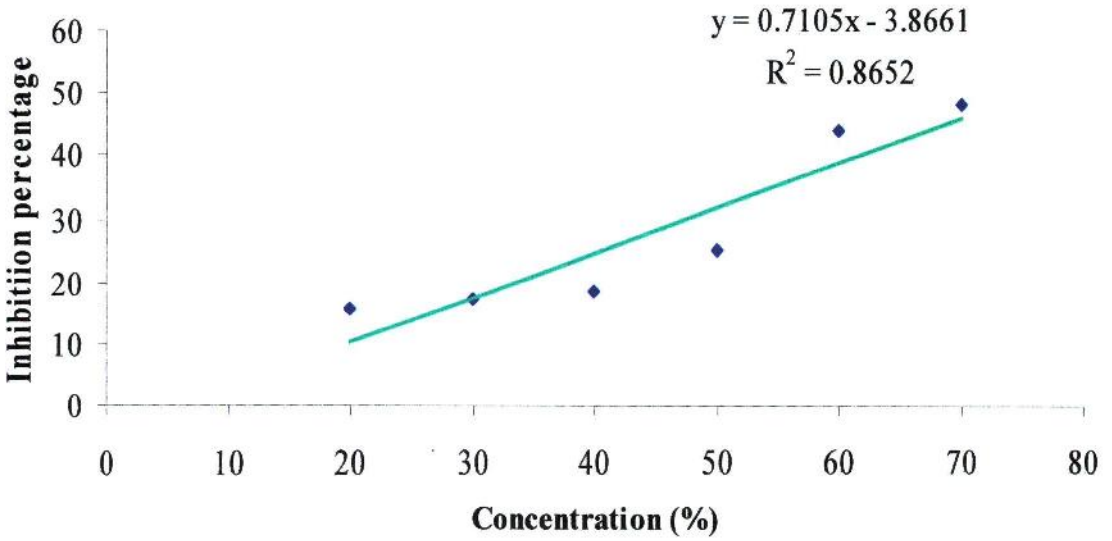

Fig. 10. Functional relationship between concentration and mycelial growth inhibition percentage on tobacco leaf in water.

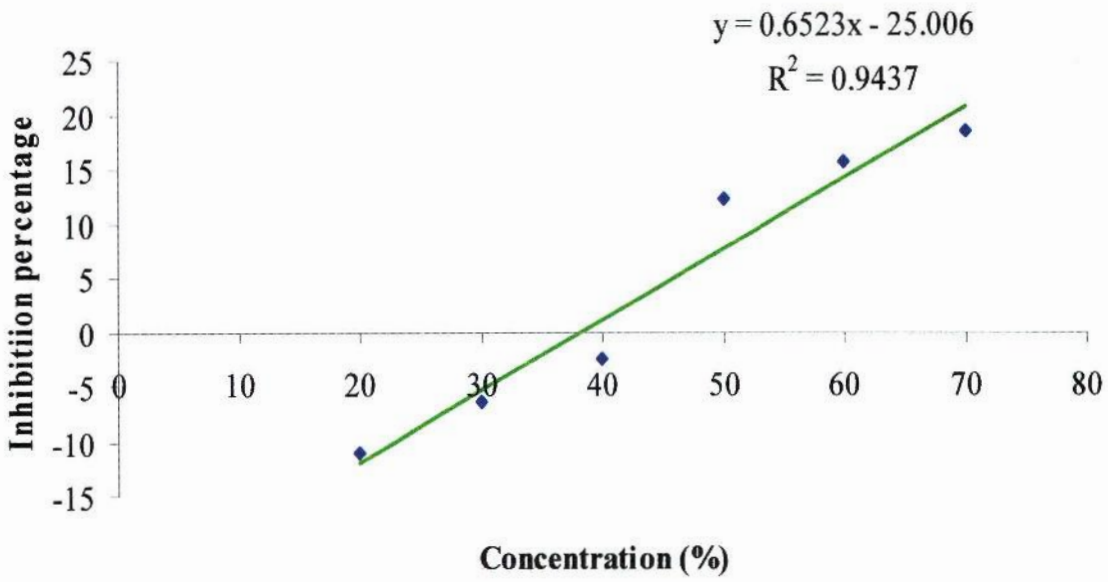

Fig. 11. Functional relationship between concentration and mycelial growth inhibition percentage on banyan leaf in water.

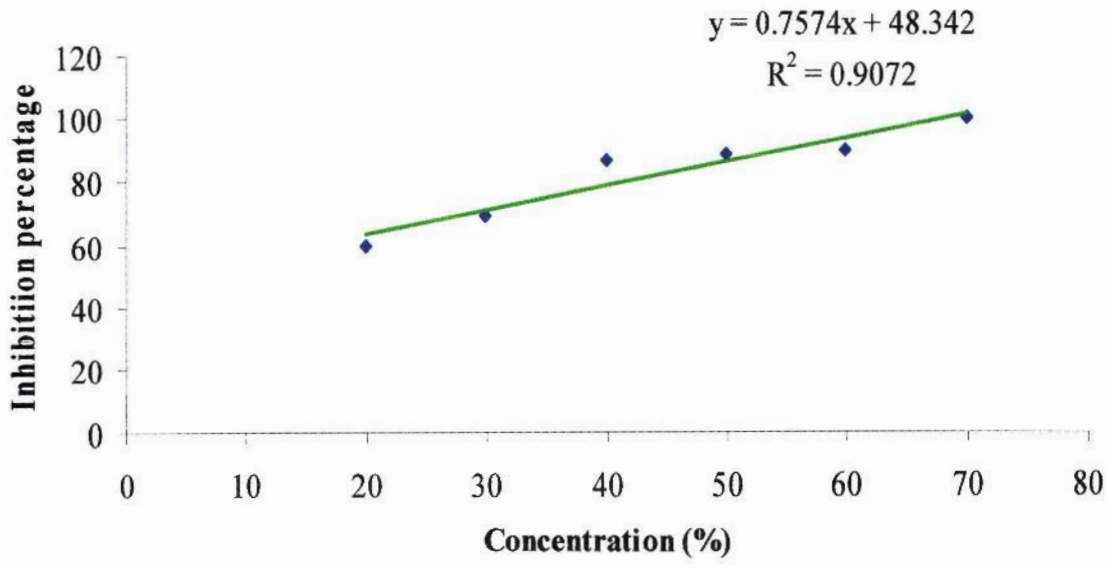

Fig. 12. Functional relationship between concentration and mycelial growth inhibition percentage on tobacco leaf in cow's urine.

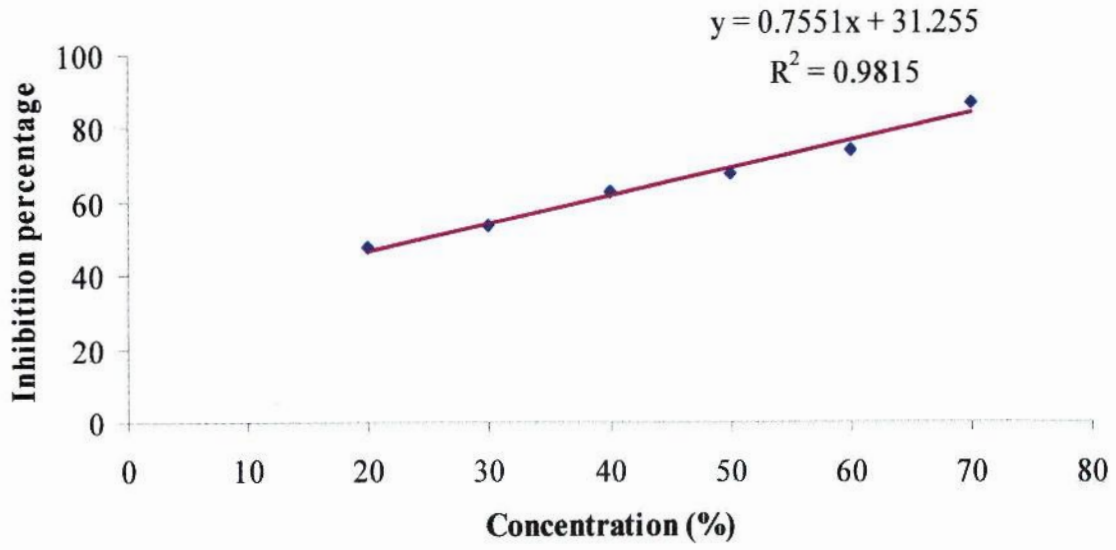

Fig. 13. Functional relationship between concentration and mycelial growth inhibition percentage on banyan leaf in cow's urine.

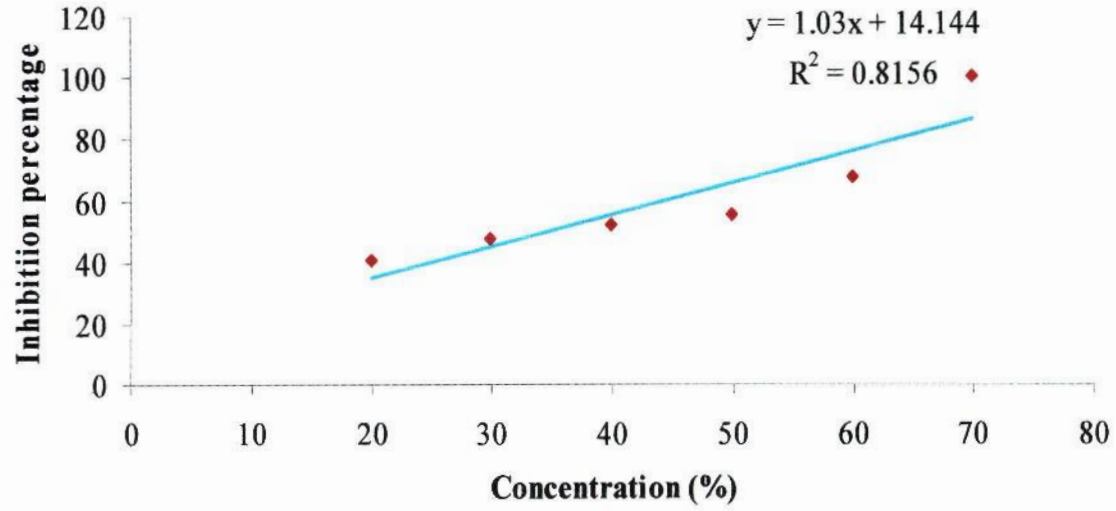

Fig. 14. Functional relationship between concentration and mycelial growth inhibition percentage on tobacco leaf and banyan leaf in cow's urine for 24 hours.

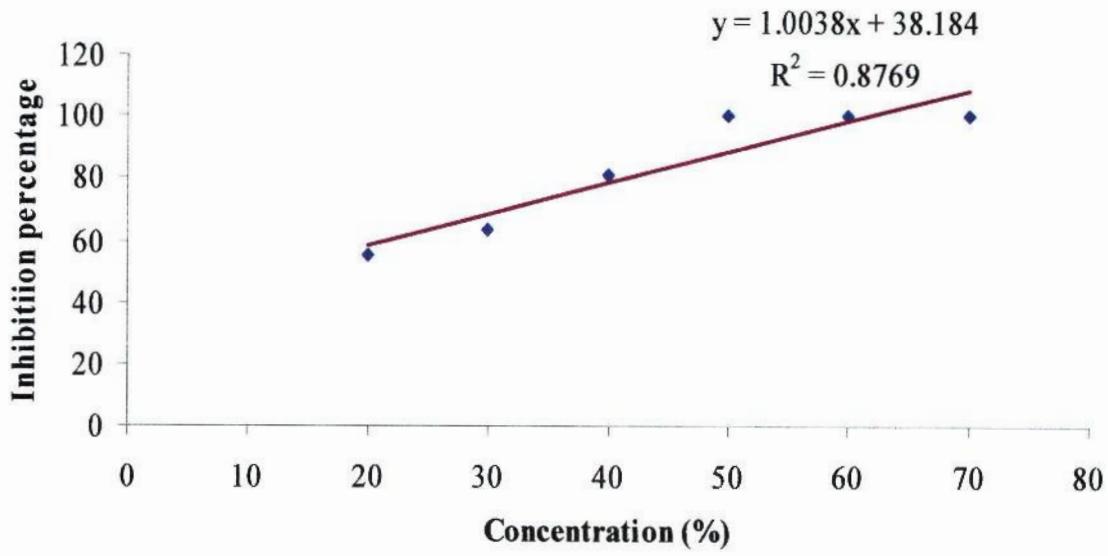

Fig. 15. Functional relationship between concentration and mycelial growth inhibition percentage on tobacco leaf and banyan leaf in cow's urine for 7 days.

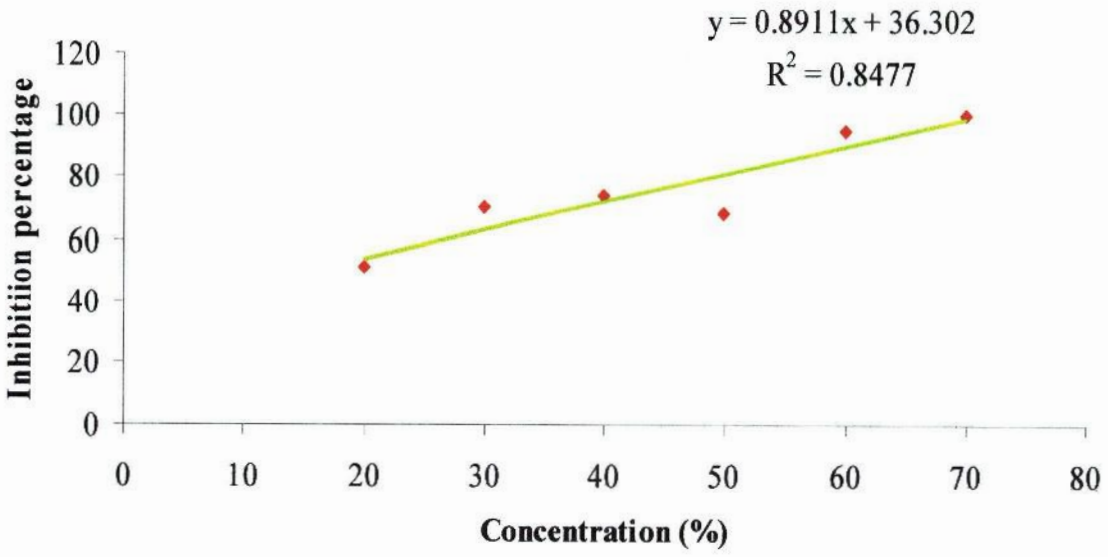

Fig. 16. Functional relationship between concentration and mycelial growth inhibition percentage on cow's urine.

Effect of different plant extracts and cows urine on spore formation of *Bipolaris sorokiniana* at different concentrations

The different plant extracts and cows urine at different concentration influence significantly ($p<0.01$) on spore formation of *B. sorokiniana* over control (Table 3).

Ginger rhizome extracts

The number of spores produced at different concentration of ginger rhizome extracts was significantly decreased with the increase of concentration (Table 3 and Fig. 17). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (20300) at 70% concentration. The number of spore (110000) produced at 20% concentration was statistically similar (92400) to 30% concentration The number of spore (75400) at 40% concentration was statistically similar (63500) to 50% concentration. Regression equation (Fig. 17) between concentration and number of spore formation revealed that almost 85% of the variation in decreased number of spore formation could be explained by the increase of concentration

Turmeric rhizome extracts

The number of spores produced at different concentration of turmeric rhizome extracts was significantly decreased with the increase of concentration (Table 3 and Fig. 18). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (624) at 70% concentration. Regression equation (Fig. 18) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the increase of concentration.

Garlic bulb extracts

The number of spores produced at different concentration of garlic bulb extracts was significantly decreased with the increase of concentration (Table 3 and Fig.

19). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (18500) was produced at 70% concentration. The number of spores (112000) produced at 20% concentration was statistically similar (98500) to 30% concentration. Regression equation (Fig. 19) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the increase of concentration.

Neem leaf extracts

The number of spores produced at different concentration of neem leaf extracts was significantly decreased with the increase of concentration (Table 3 and Fig. 20). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (56600) at 70% concentration. The number of spore (95000) produced at 30% concentration was statistically similar (87000) to 40% concentration and the number of spore (70000) at 50% concentration was statistically similar (69500) to 60% concentration. Regression equation (Fig. 20) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the increase of concentration

Nishindha leaf extracts

The number of spores produced at different concentration of nishindha leaf extracts was significantly decreased with the increase of concentration (Table 3 and Fig. 21). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (6000) at 70% concentration. Regression equation (Fig. 21) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the variation increase of concentration.

Datura leaf extracts

The number of spores produced at different concentration of datura leaf extracts was significantly decreased with the increase of concentration (Table 3 and Fig. 22). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (51000) at 70% concentration. The number of spore (116500) produced at 30% concentration was statistically similar (103500) to 40% concentration. The number of spore (103500) at 40% concentration was statistically similar (92500) to 50% concentration and the number of spore (92500) at 50% concentration was statistically similar (81000) to 60% concentration. Regression equation (Fig. 22) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the increase of concentration.

Marigold leaf extracts

The number of spores produced at different concentration of marigold leaf extracts was found to be significantly decreased with the increase of concentration (Table 3 and Fig. 23). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (107000) at 70% concentration. Regression equation (Fig. 23) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the increase of concentration.

Tobacco leaf in water

The number of spores produced at different concentration of tobacco leaf in water was significantly decreased with the increase of concentration (Table 3 and Fig. 24). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (1660) was produced at 70% concentration which was statistically similar to 60% c0ncentration (1880 The number of spore (2500) at 40% concentration was statistically similar (2220) to

50% concentration and the number of spore (2220) at 50% concentration was statistically similar (1880) to 60% concentration. Regression equation (Fig. 24) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the increase of concentration.

Banyan leaf in water

The number of spores produced at different concentration of banyan leaf in water was significantly decreased with the increase of concentration (Table 3 and Fig. 25). The highest number of spores (1250000) was produced at control condition (0% concentration) the lowest number of spores (103000) at 70% concentration which was statistically similar (112500) to 60% concentration. The number of spores (205000) was produced at 20% concentration was statistically similar (186500) to 30% concentration. The number of spore (186500) at 30% concentration was statistically similar (161500) to 40% concentration and the number of spore (161500) at 40% concentration was statistically similar (139000) to 50% concentration. Regression equation (Fig. 25) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the increase of concentration.

Tobacco leaf in cow's urine

The number of spores produced at different concentration of tobacco leaf in cow's urine was significantly decreased with the increase of concentration (Table 3 and Fig. 26). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest (178) at 60% concentration which was statistically similar to 40% concentration was statistically similar to 50% (196) and 40% (212) concentration and no spore was formed at 70% concentration. The number of spores (306) produced at 20% concentration was statistically similar (268) to 30% concentration. Regression equation (Fig. 26) between concentration and number of spore formation revealed that more than

85% of the variation in decreased number of spore formation could be explained by the increase of concentration.

Banyan leaf in cow's urine

The number of spores produced at different concentration of banyan leaf in cow's urine was significantly decreased with the increase of concentration (Table 3 and Fig. 27). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (640) at 70% concentration. The number of spores (3780) produced at 20% concentration was statistically similar (3300) to 30% concentration. Regression equation (Fig. 27) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the increase of concentration.

Tobacco leaf and banyan leaf in cow's urine for 24 hours

The number of spores produced at different concentration of tobacco leaf and banyan leaf in cow's urine was significantly decreased with the increase of concentration (Table 3and Fig. 28). The highest number of spores (1250000) was produced at control condition (0% concentration) and the lowest number of spores (220) at 60% concentration and at 70% concentration no spore was formed. Regression equation (Fig. 28) between concentration and number of spore formation revealed that more than 85% of the variation in decreased number of spore formation could be explained by the increase of concentration.

Tobacco leaf and banyan leaf in cow's urine for 7 days

There was no spore formed at any concentration due to the addition of cow's urine (Table 3 and Fig. 29).

Cow's urine

The spore formation was zero at all the concentration of cow's urine (Table 3 and Fig. 30).

Table 3. Effect of the different plant extract and cows urine at different concentration on spore formation of *Bipolaris sorokiniana*

Plant extract and biocide	No. of spore at different concentration						
	0%	20%	30%	40%	50%	60%	70%
Ginger rhizome	1250000 a (6.095)	110000 b (5.041)	92400 c (4.965)	75400 d (4.877)	63500 d (4.802)	46000 e (4.660)	20300 f (4.302)
Turmeric rhizome	1250000 a (6.095)	744 b (3.192)	1380 c (3.140)	1212 d (3.082)	924 e (2.964)	840 f (2.921)	624 g (2.794)
Garlic bulb	1250000 a (6.095)	112000 b (5.049)	98500 b (4.993)	59500 c (4.769)	39000 d (4.591)	29600 e (4.467)	18500 f (4.261)
Neem leaf	1250000 a (6.095)	89600 b (5.043)	95000 c (4.977)	87000 c (4.939)	70000 d (4.844)	69500 d (4.842)	56600 e (4.750)
Nishindha leaf	1250000 a (6.095)	104100 b (5.017)	82000 c (4.913)	63000 d (4.798)	24000 e (4.376)	14500 f (4.158)	6000 g (3.769)
Datura leaf	1250000 a (6.095)	142000 b (5.152)	116500 c (5.066)	103500 cd (5.015)	92500 de (4.966)	81000 e (4.907)	51000 f (4.707)
Marigold leaf	1250000 a (6.095)	645000 b (5.809)	535000 c (5.728)	400000 d (5.601)	260000 d (5.414)	180000 f (5.253)	107000 g (5.029)
Tobacco in water	1250000 a (6.095)	28000 b (4.445)	4600 c (3.662)	2500 d (3.398)	2220 de (3.345)	1880 ef (3.274)	1660 f (3.217)
Banyan leaf in water	1250000 a (6.095)	205000 b (5.306)	186500 bc (5.270)	161500 cd (5.208)	139000 d (5.142)	112500 e (5.051)	103000 e (5.013)

Continued							
Tobacco in cows urine	1250000 a (6.095)	306 b (2.486)	268 b (2.425)	212 bc (2.328)	196 c (2.293)	178 c (2.250)	000 d (.000)
Banyan leaf in cows urine	1250000 a (6.095)	3780 b (3.577)	3300 b (3.513)	2700 c (3.430)	1840 d (3.264)	1080 e (3.030)	640 f (2.801)
Tobacco leaf and Banyan leaf in cows urine for 24 hours	1250000 a (6.095)	1060 b (3.025)	520 c (2.717)	366 d (2.564)	282 e (2.451)	220 f (2.343)	000 g (0.000)
Tobacco and Banyan leaf in cows urine for 7 days	1250000 a (6.095)	000 b (0.000)	000 b (0.000)	000 b (0.000)	000 b (0.000)	000 b (0.000)	000 b (0.000)
Cows urine	1250000 a (6.095)	000 b (0.000)	000 b (0.000)	000 b (0.000)	000 b (0.000)	000 b (0.000)	000 b (0.000)
CV (%)	1.85						

Figure in the row with similar letters do not differ significantly at 1% level.
The values in the parentheses are log transformed value.

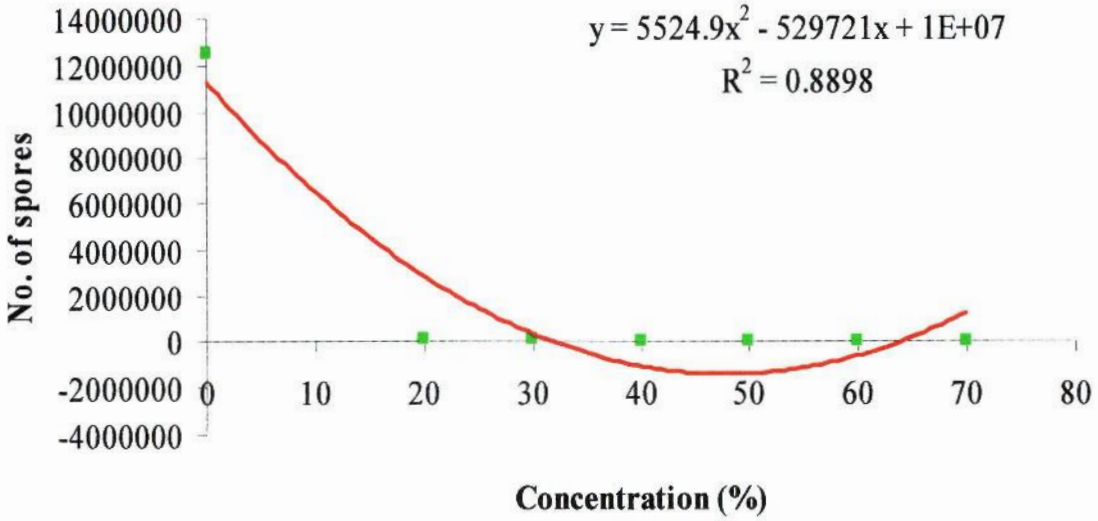

Fig. 19. Functional relationship between concentration and number of spore on garlic bulb extract.

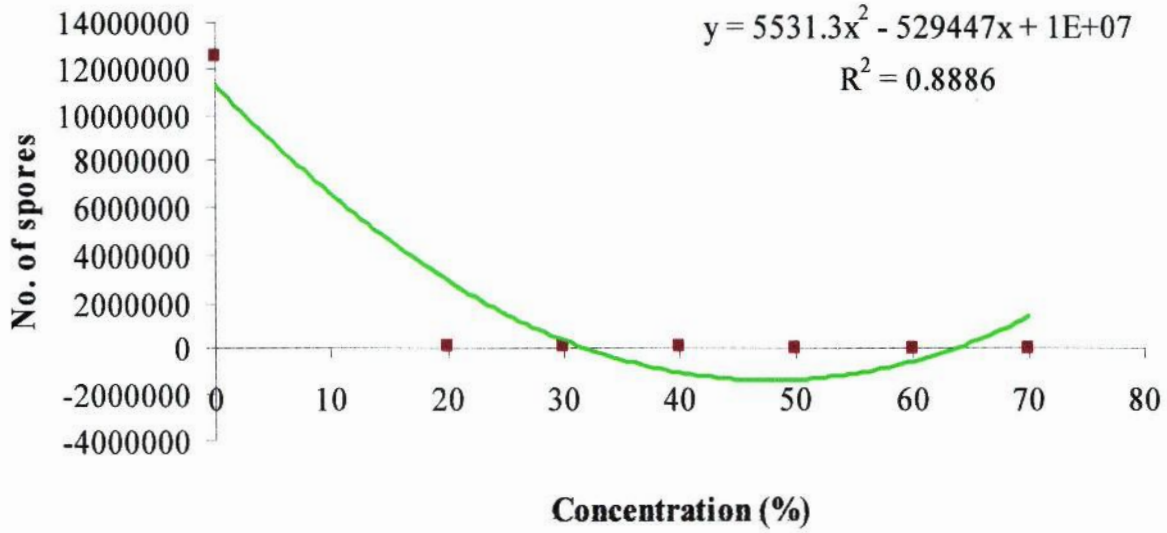

Fig. 20. Functional relationship between concentration and number of spore on neem leaf extract.

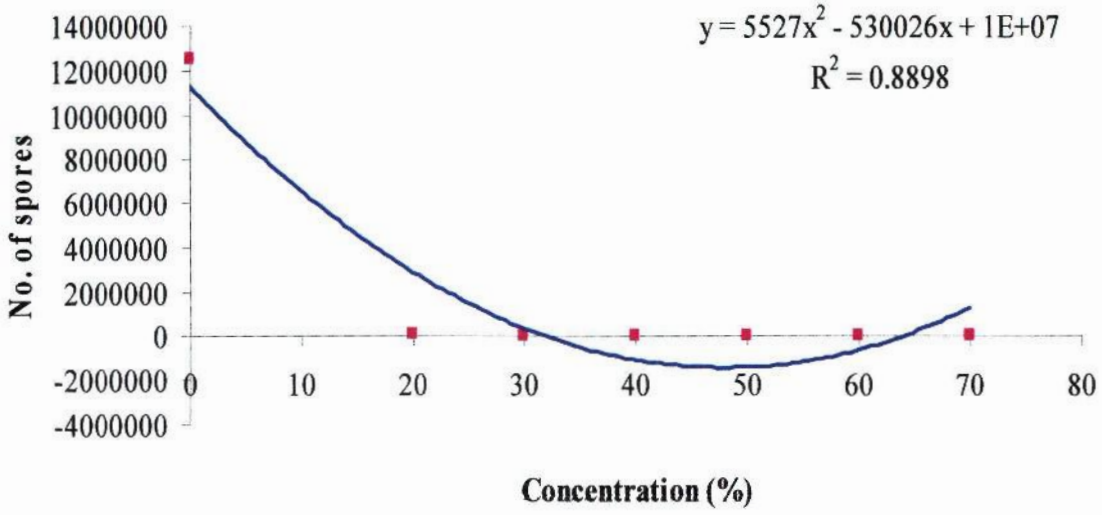

Fig. 21. Functional relationship between concentration and number of spore on nishindha leaf extract

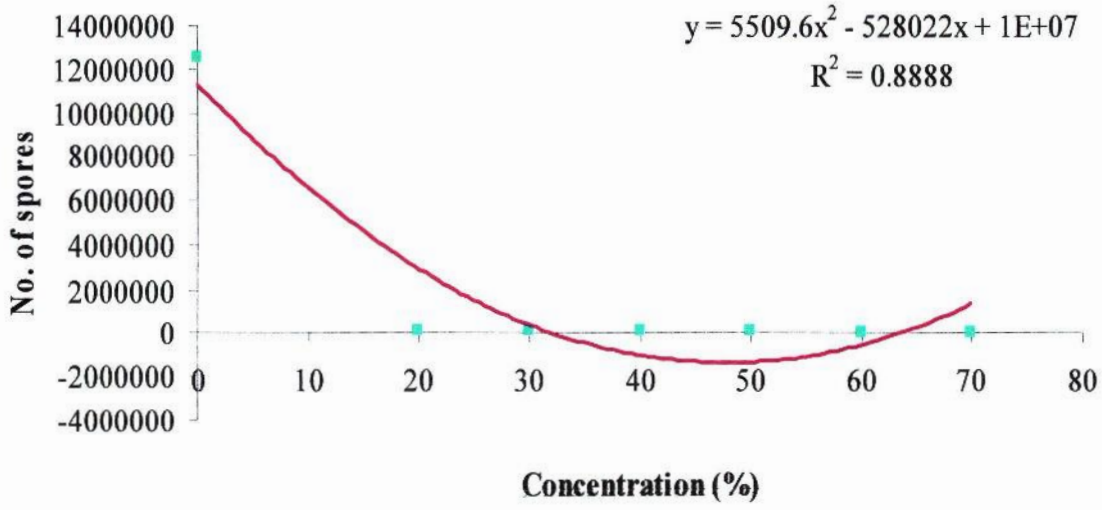

Fig. 22. Functional relationship between concentration and number of spore on datura leaf extract.

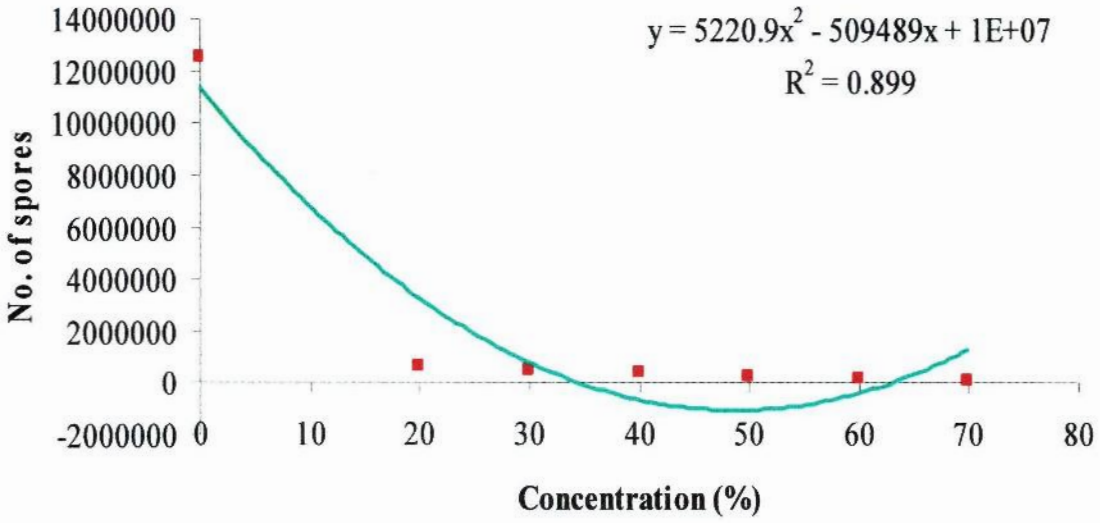

Fig. 23. Functional relationship between concentration and number of spore on marigold leaf extract

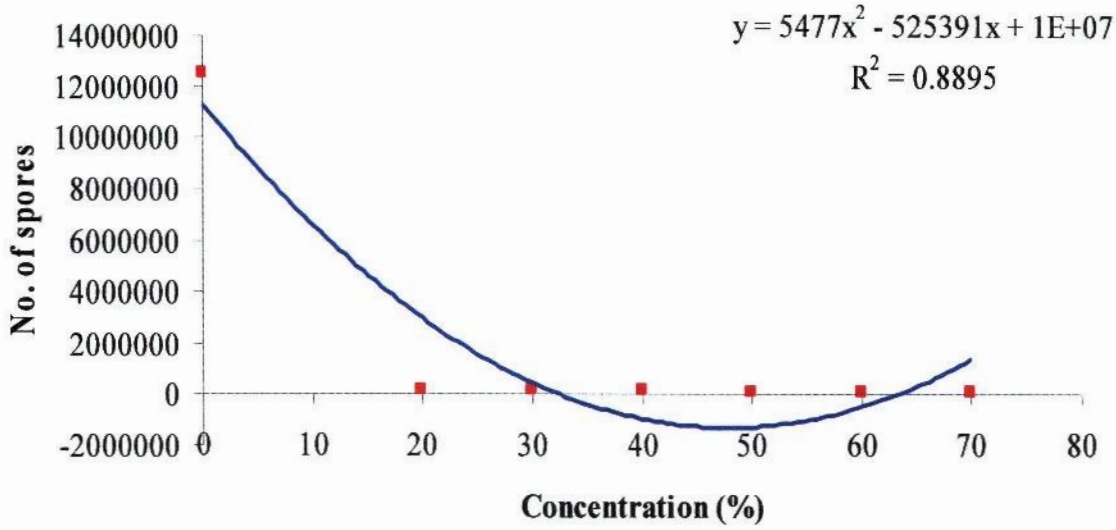

Fig. 24. Functional relationship between concentration and number of spore on tobacco leaf in water.

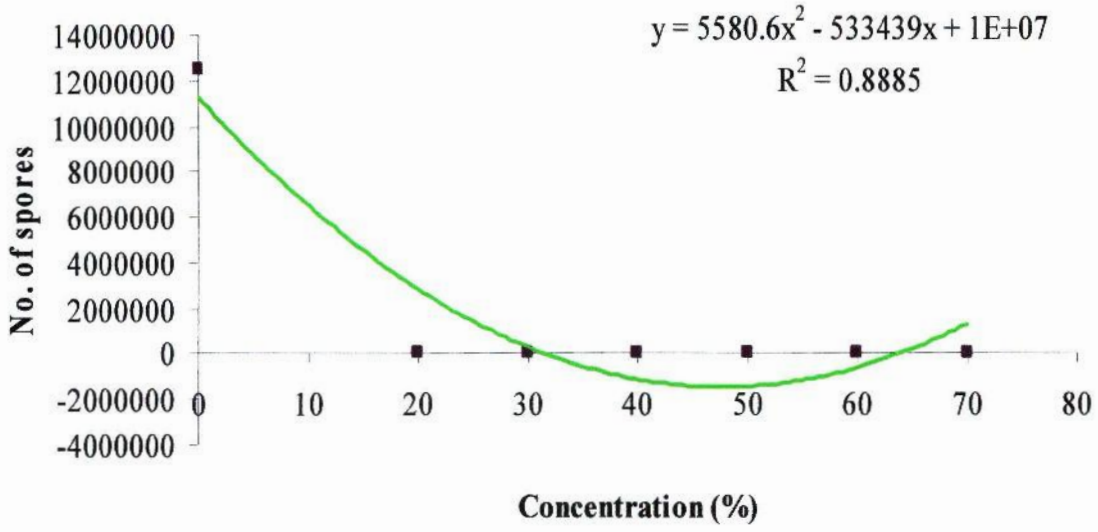

Fig. 25. Functional relationship between concentration and number of spore on banyan leaf in water

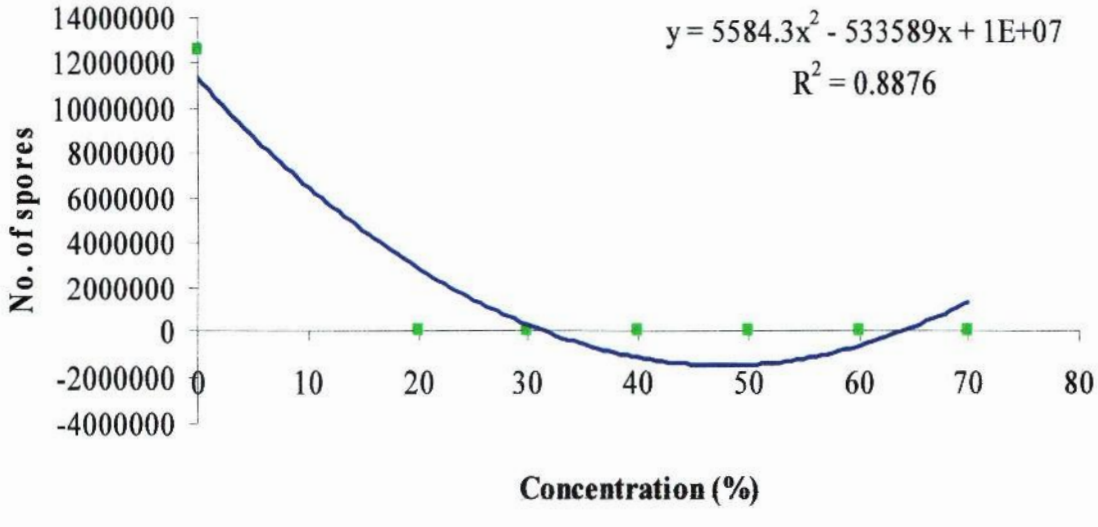

Fig. 26. Functional relationship between concentration and number of spore on tobacco on cow's urine

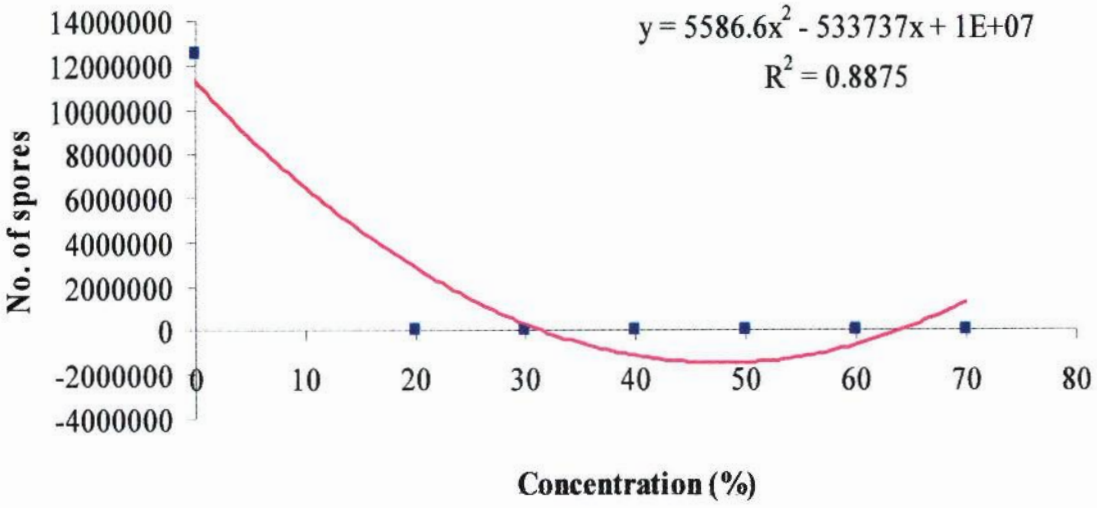

Fig. 27. Functional relationship between concentration and number of spore on banyan leaf in cow's urine

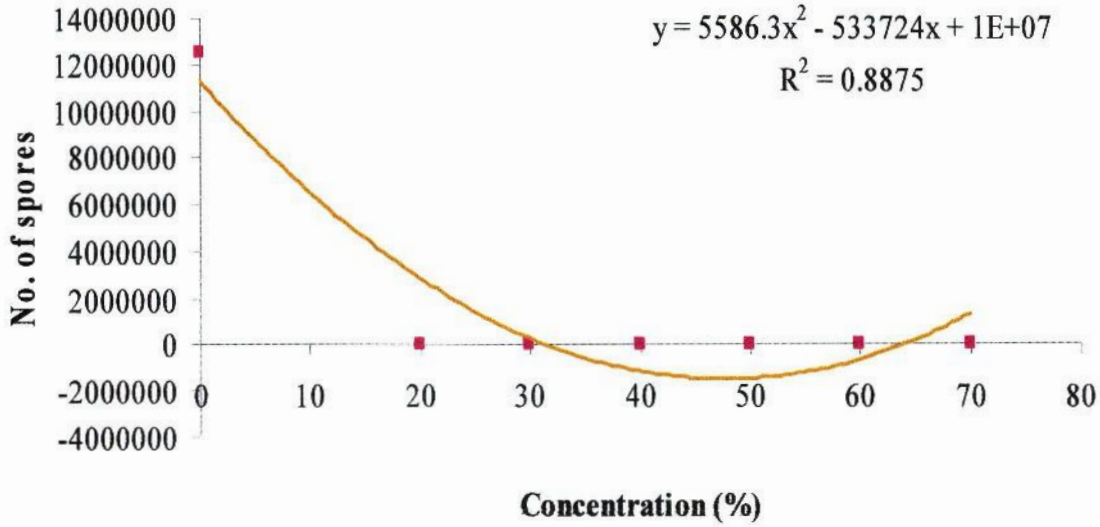

Fig. 28. Functional relationship between concentration and number of spore on tobacco leaf and banyan leaf in cow's urine for 24 hours.

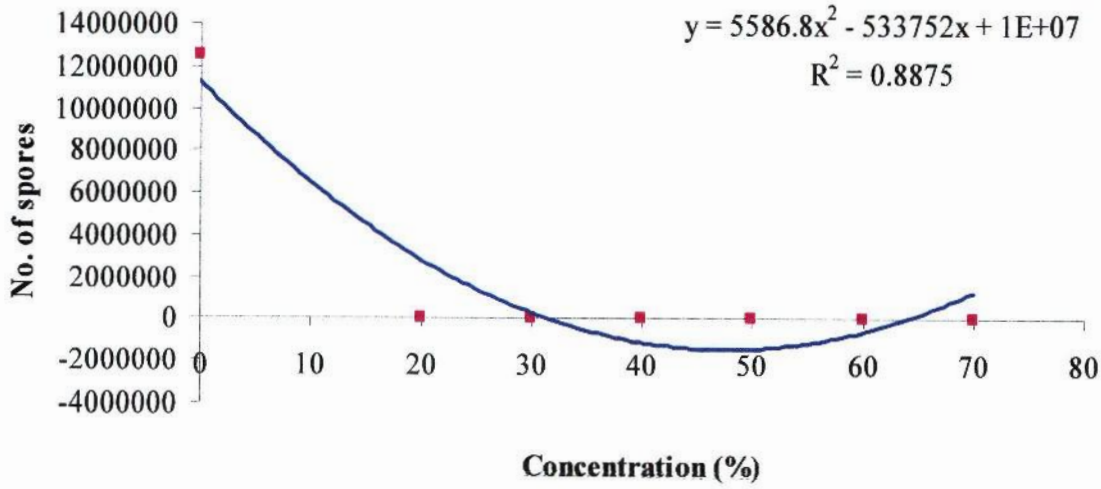

Fig. 29. Functional relationship between concentration and number of spore on tobacco leaf and banyan leaf in cow's urine for 7 days.

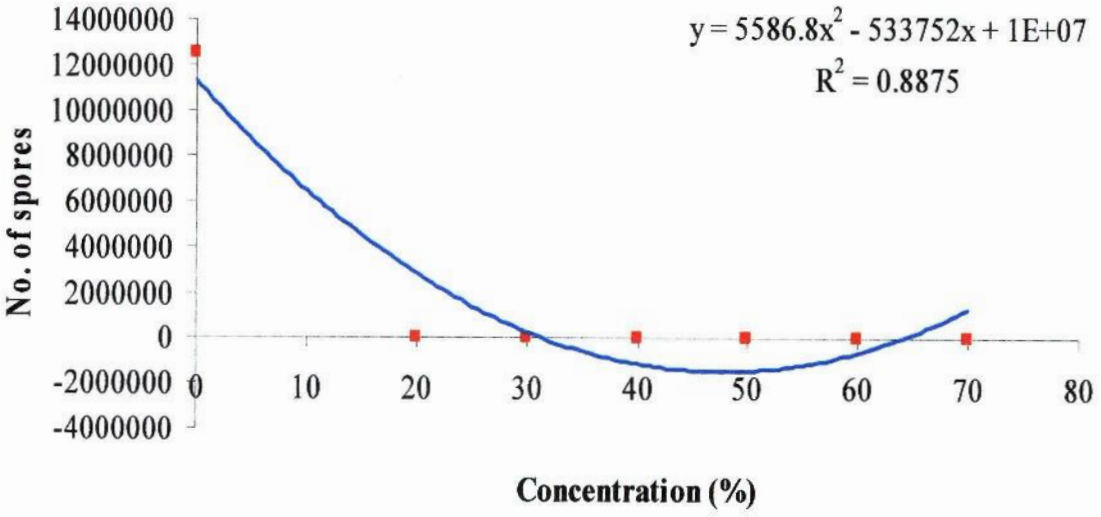

Fig. 30. Functional relationship between concentration and number of spore on cow's urine

Effect of different plant extracts and cows urine on mycelial growth of *Bipolaris sorokiniana* at different specific concentration

The different plant extracts and cows urine at specific concentration significantly and differently ($p<0.01$) inhibit the mycelial growth of *B. sorokiniana* over control (Table 4).

Different plant extracts and cows urine at 20% concentration

The mycelial growth inhibition was significantly differing due to the addition of different plant extracts and cows urine at a specific concentration (Table 4). The highest percentage inhibition (64.62%) was observed in turmeric rhizome extract and the lowest percentage inhibition (9.51%) was observed in datura leaf extract. Here also the mycelial growth increased in garlic leaf extracts, nishindha leaf extracts, marigold leaf extract and banyan leaf in water and were 4.06%, 4.24%, 5.77 and 11.04% respectively.

Different plant extracts and cows urine at 30% concentration

The mycelial growth inhibition was significantly differing due to the addition of different plant extracts and cows urine at a specific concentration (Table 4). The highest percentage inhibition (70.07) was observed in cow's urine which was statistically similar to tobacco leaf in cow's urine (69.62) and the lowest percentage inhibition (8.33%) was in marigold leaf extract. The percentage inhibition in tobacco leaf in cow's urine (69.62) was statistically similar to turmeric leaf extract (68.26). The percentage inhibition in garlic leaf extract (-2.340) was statistically similar to nishindha ł leaf extract (1.594). The mycelial growth increased in garlic leaf extracts, nishindha leaf extracts and banyan leaf in water and were 2.34%, 1.59% and 6.53% respectively.

Different plant extracts and cows urine at 40% concentration

The mycelial growth inhibition was significantly differing due to the addition of different plant extracts and cows urine at a specific concentration (Table 4). The highest percentage inhibition (86.62%) was observed in tobacco leaf in cow's urine (86.62%) and the lowest percentage inhibition was negative (9.97%)

marigold leaf extract. The percentage inhibitions in datura leaf extract (17.46) were statistically similar to tobacco in water (18.59). Here also the mycelial growth inhibition increased over control in banyan leaf in water.

Different plant extracts and natural cows' urine at 50% concentration

The mycelial growth inhibition was significantly differing due to the addition of different plant extracts and cows urine at a specific concentration (Table 4). The highest percentage inhibition (100%) was observed in tobacco leaf and banyan leaf in cow's urine for 7 days (100%) and the lowest percentage inhibition (12.24%) was in banyan leaf in water. The percentage inhibition in neem leaf extracts (25.17) which was statistically similar to tobacco in water (25.07).

Different plant extracts and cows urine at 60% concentration

The mycelial growth inhibition was significantly differing due to the addition different plant extracts and cows urine at a specific concentration (Table 4). The highest percentage inhibition (100%) was observed in tobacco leaf and banyan leaf in cow's urine for 7 days (100%) and the lowest percentage inhibition (15.64%) was in banyan leaf in water. The percentage inhibition in turmeric rhizome extract (72.56) was statistically similar to banyan leaf in cow's urine (73.92) and the percentage inhibition in neem leaf extract (25.85) which was statistically similar to datura leaf extract (24.95) and marigold leaf extract (25.62).

Different plant extracts and cows urine at 70% concentration

The mycelial growth inhibition was significantly differing due to the addition different plant extracts and cows urine at a specific concentration (Table 4). The highest percentage inhibition (100%) was observed in tobacco leaf and banyan leaf in cow's urine for 7 days was statistically similar to tobacco leaf and banyan leaf in cow's urine for 24 hours (100%) cow's urine (100%) and tobacco leaf in cow's urine (100%) and the lowest percentage inhibition (18.36%) was in banyan leaf in water. The percentage inhibition in neem leaf extract (29.70) was statistically similar to datura leaf extract (29.92).

Table 4. Effect of the different plant extract and cows urine at specific concentration on growth inhibition of *Bipolaris sorokiniana*

Plant extract and biocide	Inhibition percentage at specific concentration					
	20%	30%	40%	50%	60%	70%
Ginger rhizome	34.46 g	40.13 f	44.44g	49.88 h	53.51 g	56.69 e
Turmeric rhizome	64.62 a	68.26 b	70.12 d	71.88 d	72.56 d	76.65 c
Garlic bulb	-4.064 k	-2.340 k	14.27 k	27.42 i	30.87 i	37.18 g
Neem leaf	17.91 h	20.40 g	22.68 i	25.17 j	25.85 j	29.70 i
Nishindha leaf	-4.242 kl	-1.594 k	31.22 h	51.69 g	62.13 f	66.44d
Datura leaf	9.5 14 j	13.15 i	17.46 j	19.49 l	24.95 j	29.92 i
Marigold leaf	-5.776 l	8.330 j	9.968 l	21.98 k	25.62 j	31.74 h
Tobacco in cows urine	59.63 b	69.62 ab	86.62 a	88.66 b	90.02 c	100.0 a
Banyan leaf in cows urine	47.42 e	53.28 d	62.36 e	67.58 e	73.92 d	86.85 b
Banyan leaf in water	-11.04 m	-6.530 l	-2.572 m	12.24 m	15.64 k	18.36 j
Tobacco in water	15.64 i	17.23 h	18.59 j	25.07 j	43.95 h	48.07 f
Tobacco leaf and Banyan leaf in cows urine for 24 hours	40.36 f	47.79 e	52.15 f	55.09 f	67.58 e	100.0 a
Cows urine	51.48 d	70.07 a	73.69 c	86.17 c	95.01 b	100.0 a
Tobacco and Banyan leaf in cows urine for 7days	55.33 c	63.62 c	81.17 b	100.0 a	100.0 a	100.0 a
CV (%)	2.90					

Figure in the column with similar letters do not differ significantly at 1% level.

Different plant extracts and cows urine on spore formation of *Bipolaris sorokiniana* at specific concentration

The different plant extracts and cows urine at specific concentration significantly ($p<0.01$) influence the formation of spore of *B. sorokiniana* over control (Table 5). The number of spore (1250000) production at control condition (0% concentration) was similar for all the treatments (plant extracts and cow`s urine).

Different plant extracts and cows urine at 20% concentration

The number of spore formation was significantly differing on different plant extracts and cows urine at a specific concentration (Table 5). The highest number of spores (645000) was formed in marigold leaf extracts and the lowest number of spore (306) in tobacco leaf in cow's urine. There was no spore formed in cow's urine and tobacco leaf and banyan leaf in cow's urine for 7 days. The number of spore (112000) in garlic bulb extract was statistically similar to nishindha leaf extract (104100) and the number of spore (89600) in neem leaf extract was statistically similar to ginger rhizome extract (110000).

Different plant extracts and cows urine at 30% concentration

The number of spore formation was significantly differing on different plant extracts and cows urine at a specific concentration (Table 5). The highest number of spores (535000) was formed in marigold leaf extracts and the lowest number of spore (268) in tobacco leaf in cow's urine but no spore formed in cow's urine and tobacco leaf and banyan leaf extract in cow's urine for 7 days. The number of spore (116500) in datura leaf extract was statistically similar to garlic extract (98500), the number of spore (924000) in ginger rhizome extract was statistically similar to neem leaf extract (95000), nishindha leaf extract (82000) and ginger rhizome extract.

Different plant extracts and cows urine at 40% concentration

The number of spore formation was significantly differing on different plant extracts and cows urine at a specific concentration (Table 5). The highest number of spores (400000) was formed in marigold leaf extracts. The lowest number of spore (212) in tobacco leaf in cow's urine. There was no spore formed in cow's urine and tobacco leaf and banyan leaf in cow's urine for 7 days. The number of spore (103500) in datura leaf extract was statistically similar to neem leaf extract (87000), the number of spore (87000) in neem leaf extract was statistically similar to ginger rhizome extract (75400), the number of spore (75400) in ginger rhizome extract was statistically similar to nishindha leaf extract (63000) and the number of spore (63000) in nishindha leaf extract was statistically similar to garlic bulb extract (59500).

Different plant extracts and cows urine at 50% concentration

The number of spore formation was significantly differing on different plant extracts and cows urine at a specific concentration (Table 5). The highest number of spores (260000) was formed in marigold leaf extracts and the lowest number of spore (282) tobacco leaf and banyan leaf in cow's urine for 24 hours was formed. In cow's urine and tobacco leaf and banyan leaf in cow's urine for 7 days no spore was formed. The number of spore (70000) in neem leaf extract was statistically similar to ginger rhizome extract (63500).

Different plant extracts and cows urine at 60% concentration

The number of spore formation was significantly differing on different plant extracts and cows urine at a specific concentration (Table 5). The highest number of spores (180000) was formed in marigold leaf extracts and lowest number of spore (178) in tobacco leaf in cow's urine. There was no spore formed in tobacco leaf and banyan leaf in cow's urine for 24 hours and tobacco leaf and banyan leaf in cow's urine for 7 days. The number of spore (81000) in datura leaf extract was statistically similar to neem leaf extract (69500).

Different plant extracts and cows urine at 70% concentration

The number of spore formation was significantly differing on different plant extracts and cows urine at a specific concentration (Table 5). The highest number of spores (107000) was formed in marigold leaf extract which was statistically similar to banyan leaf in water (103000) and the lowest number of spore (640) in banyan leaf in cow's urine which was statistically similar to turmeric rhizome extract (624). Here no spore was formed in tobacco leaf in cow's urine, tobacco leaf and banyan leaf in cow's urine, cow's urine for 24 hours, tobacco leaf and banyan leaf in cow's urine for 7 days. The number of spore (56600) in neem leaf extract was statistically similar to datura leaf extract (51000) and the number of spore (18500) in garlic bulb extract was statistically similar to ginger rhizome extract (20300)

Table 5. Effect of the different plant extract and cows urine at specific concentration on spore formation of *Bipolaris sorokiniana*

Plant extract and biocide	No. of spore at different concentration						
	0%	20%	30%	40%	50%	60%	70%
Ginger rhizome	1250000 a (6.095)	110000 e (5.041)	92400 d (4.965)	75400 de (4.877)	63500 d (4.802)	46000 d (4.660)	20300 c (4.302)
Turmeric rhizome	1250000 a (6.095)	744 h (3.192)	1380 g (3.140)	1212 h (3.082)	924 i (2.964)	840 i (2.921)	624 f (2.794)
Garlic bulb	1250000 a (6.095)	112000 d (5.049)	98500 cd (4.993)	59500 f (4.769)	39000 e (4.591)	29600 e (4.467)	18500 c (4.261)
Neem leaf	1250000 a (6.095)	89600 e (5.043)	95000 d (4.977)	87000 cd (4.939)	70000 d (4.844)	69500 c (4.842)	56600 b (4.750)
Nishindha leaf	1250000 a (6.095)	104100 d (5.017)	82000 d (4.913)	63000 ef (4.798)	24000 f (4.376)	14500 f (4.158)	6000 d (3.769)
Datura leaf	1250000 a (6.095)	142000 c (5.152)	116500 c (5.066)	103500 c (5.015)	92500 c (4.966)	81000 c (4.907)	51000 b (4.707)
Marigold leaf	1250000 a (6.095)	645000 a (5.809)	535000 a (5.728)	400000 a (5.601)	260000 a (5.414)	180000 a (5.253)	107000 a (5.029)
Tobacco in water	1250000 a (6.095)	28000 f (4.445)	4600 e (3.662)	2500 g (3.398)	2220 g (3.345)	1880 g (3.274)	1660 e (3.217)
Banyan leaf in water	1250000 a (6.095)	205000 b (5.306)	186500 b (5.270)	161500 b (5.208)	139000 b (5.142)	112500 b (5.051)	103000 a (5.013)

Continued							
Tobacco in cows urine	1250000 a (6.095)	306 j (2.486)	268 i (2.425)	212 j (2.328)	196 k (2.293)	178 k (2.250)	000 g (.000)
Banyan leaf in cows urine	1250000 a (6.095)	3780 g (3.577)	3300 f (3.513)	2700 g (3.430)	1840 h (3.264)	1080 h (3.030)	640 f (2.801)
Tobacco leaf and Banyan leaf in cows urine for 24 hours	1250000 a (6.095)	1060 i (3.025)	520 h (2.717)	366 i (2.564)	282 j (2.451)	220 j (2.343)	000 g (0.000)
Tobacco and Banyan leaf in cows urine for 7 days	1250000 a (6.095)	000 k (0.000)	000 j (0.000)	000 k (0.000)	000 l (0.000)	000 l (0.000)	000 g (0.000)
Cows urine	1250000 a (6.095)	000 k (0.000)	000 j (0.000)	000 k (0.000)	000 l (0.000)	000 l (0.000)	000 g (0.000)
CV (%)	1.60						

Figure in the column with similar letters do not differ significantly at 1% level.
The values in the parenthesis are log transformed value

Functional relationship between concentration and mycelial growth inhibition percentage of *Bipolaris sorokiniana*

In case of tobacco leaf and banyan leaf in cow's urine for 7 days the mycelial growth inhibition percentage was increased with the increment of concentration (Fig. 31). So, they were positively related. Regression equation between concentration and inhibition percentage also revealed that more than 87% of the variation in inhibition percentage could be explained by the variation of concentration. In case of tobacco leaf and banyan leaf in cows urine for 24 hours mycelial growth inhibition percentage was increased with the increased of concentration (Fig. 31). So, they were positively related. Regression equation between concentration and inhibition percentage also revealed that more than 81% of the variation in inhibition percentage could be explained by the variation of concentration. However, tobacco leaf and banyan leaf in cow's urine for 7 days perform better relationship with mycelial growth inhibition percentage than tobacco leaf and banyan leaf in cow's urine for 24 hours.

Functional relationship between concentration and number of spore formation of *Bipolaris sorokiniana*

In case of tobacco leaf and banyan leaf in cow's urine for 24 hours the number of spore formation was decreased with the increment of concentration (Fig. 32). So, they were negatively related. Regression equation between concentration and number of spore formation also revealed that more than 84% of the variation in inhibition percentage could be explained by the variation of concentration. In case of tobacco leaf and banyan leaf in cow's urine for 7 days number of spore formation was same at all concentration (Fig. 32). So there was no relationship found.

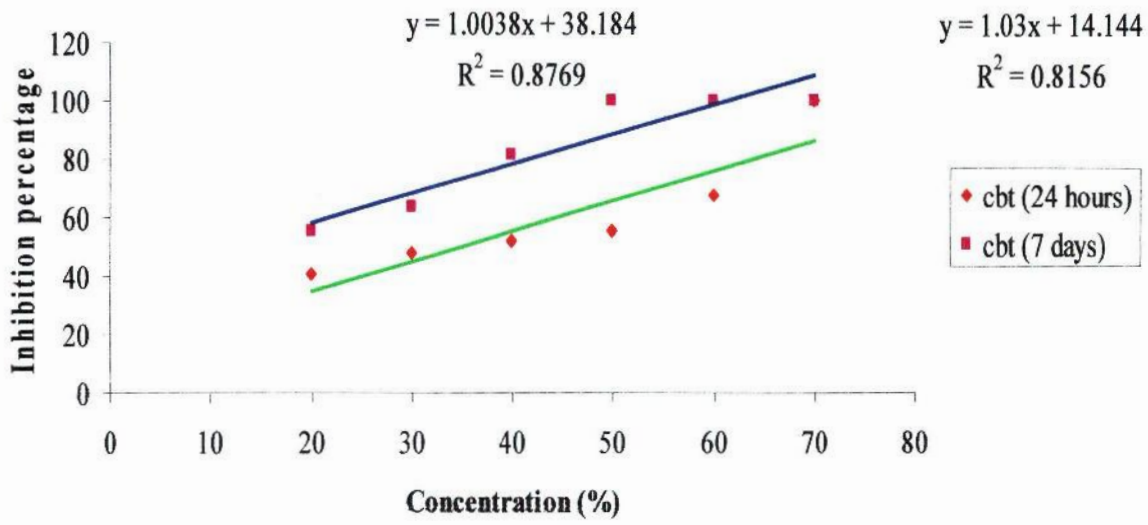

Fig. 31. Functional relationship between concentration and mycelial growth inhibition percentage of tobacco leaf and banyan leaf in cow's urine for 24 hours and tobacco leaf and banyan leaf in cow's urine for 7days.

Here,

Cbt (24 hours) = Tobacco leaf and banyan leaf in cows urine for 24 hours
Cbt (7 days) = Tobacco leaf and banyan leaf in cows urine for 7 days

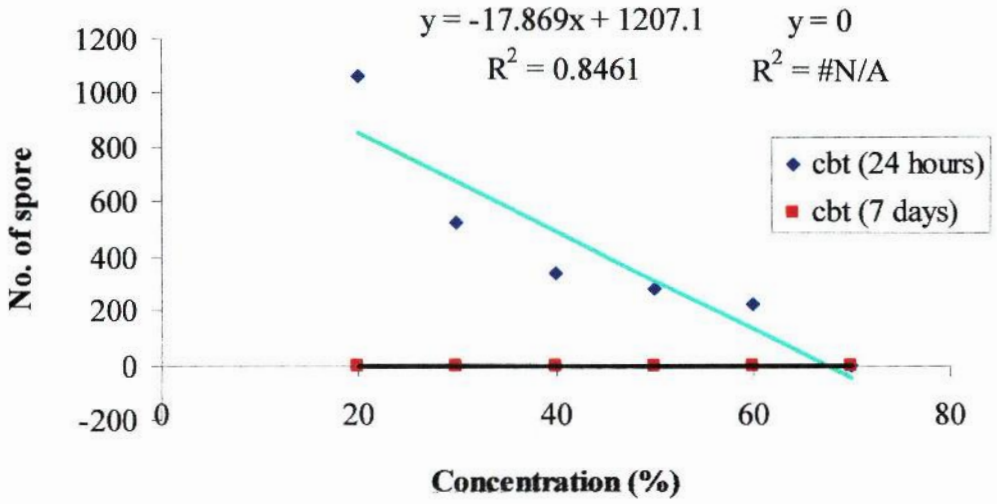

Fig. 32. Functional relationship between concentration and no. of spore of tobacco leaf and banyan leaf in cow's urine for 24 hours and tobacco leaf and banyan leaf in cow's urine for 7days.

Here,

Cbt (24 hours) = Tobacco leaf and banyan leaf in cows urine for 24 hours
Cbt (7 days) = Tobacco leaf and banyan leaf in cows urine for 7 days

Relationship between concentration and mycelial growth inhibition percentage of *Bipolaris sorokiniana*

In all the cases (tobacco leaf in cows urine, banyan leaf in cows urine, tobacco leaf and banyan leaf in cows urine for 24 hours, tobacco leaf and banyan leaf in cows urine for 7 days and cows urine) the mycelial growth inhibition percentage was increased with the increased of concentration (Fig. 33). The mycelial growth inhibition percentage was higher at all the concentration except 70% concentration. In the 70% concentration the mycelial growth inhibition percentage was similar (100%) at all the treatments.

Relationship between concentration and number of spore formation of *Bipolaris sorokiniana*

In all the cases (tobacco leaf in cows urine, banyan leaf in cows urine, tobacco leaf and banyan leaf in cows urine for 24 hours, tobacco leaf and banyan leaf in cows urine for 7 days and cows urine) the number of spore formation was decreased with the increased of concentration (Fig. 34). The number of spore formation was higher at all the concentration. But in two treatments as tobacco leaf and banyan leaf in cow's urine for 7 days and cow's urine the number of spore was zero i.e. there was no spore formed in this two treatments.

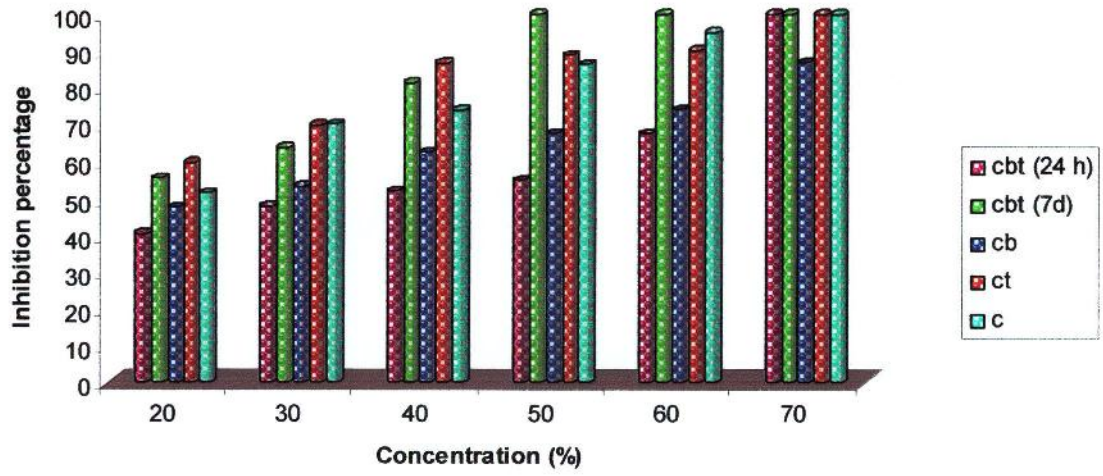

Fig. 33. Relationship between mycelial growth inhibition and different plant extracts in cows urine (plant extracts kept for 24 hours and 7 days in cows urine) and cows urine at different concentration.

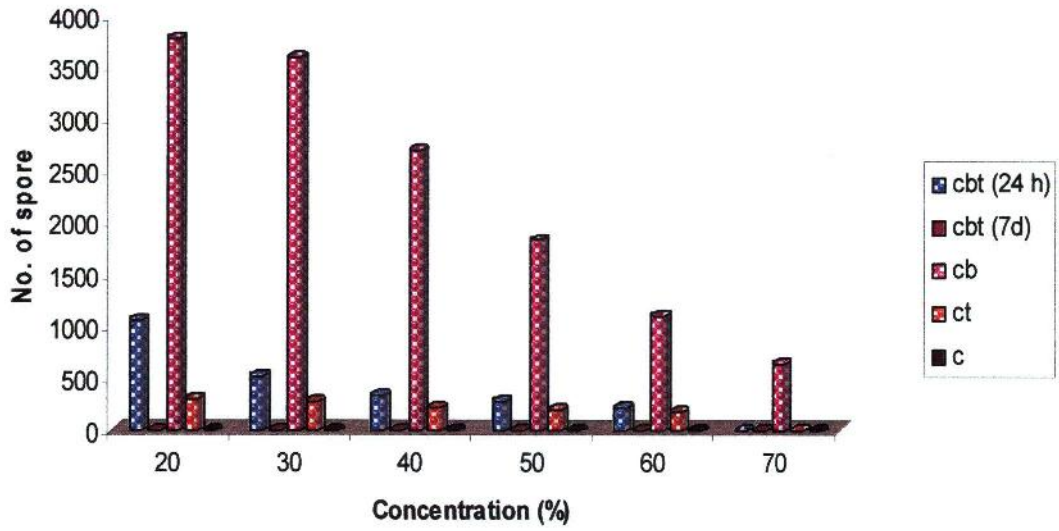

Fig. 34 Relationship between number of spore and different plant extracts in cows urine (plant extracts kept for 24 hours and 7 days in cows urine) and cows urine at different concentration.

Here in Fig. 33 and Fig. 34-

Cbt (24 h) = Tobacco leaf and banyan leaf in cows urine for 24 hours

Cbt (7 d) = Tobacco leaf and banyan leaf in cows urine for 7 days

Cb = Banyan leaf in cows urine

Ct = Tobacco leaf in cows urine

C = Cows urine

DISCUSSION

DISCUSSION

Leaf blotch/leaf blight disease of wheat caused by *B. sorokiniana* occurs in all part of the world specially in rice wheat cropping system (Ekboir, 2002). In recent time this is the most devastating disease in Bangladesh (Alam *et al.*, 1998). As this pathogens has wide host range it is difficult to control. No ideal measure to control this disease has been developed. Only chemical of some groups are used to control this disease.

Now-a-days chemical control is being discouraged at least where there is any other environment friendly alternatives are available to control disease. To control this disease effort has been given to discover different biological extracts. (Ashrafuzzaman and Hossain, 1992; Hossian *et al,* 1993; Khan and Hossain, 1993; Hossain *et al.*, 1997).

Chemical fungicides are hazardous to human health and nature. Considering this attempt is being made all over the world to discover plant extract and biocides against plant diseases. Fortunately some plants have been identified as having reasonable antifungal qualities. Specially some plant extracts have been proved very effective against some fungi (Tewari, 2006).

In the present experiment attempt has been made to evaluate the effect of different plant extracts and cows urine on mycelial growth and formation of spore *in vitro* against *B. sorokiniana* of wheat. The extracts and cows urine either as itself or as solvent of different plant extracts in different concentration administered with an aim to identify the most effective ones.

Extracts of *Allium sativum* was found effective against *B. sorokiniana* by different researchers. It was found effective in reducing spore germination and mycelial growth of *B. sorokiniana* showed positive anti-fungal activity in reducing the pathogenecity of *B. sorokiniana* on wheat leaves (Hossain *et al.* 1993; Khan and Hossain, 1993; Hossain *et al.*, 1997).

The result of the present study regarding garlic bulb extracts and neem leaf extracts represents that even at 70% concentration mycelial growth inhibition was less than 40% and 30% respectively which does not confirm the previous results. On the other hand garlic extracts obviously reduced the spore production which is in agreement the previous results.

Neem (*Azadirachta indica*), garlic (*Allium sativum*), onion (*Allium cepa*) and biskatali (*Polygonum hydropiper*); among that neem and garlic extracts were effective against *Bipolaris oryzae* at 1:1 dilution (Ahmed and Islam, 2000).

In all treatments radial growth inhibition was increased with the increased level of concentration. In 70% concentration the radial growth inhibition above 50% was observed in ginger rhizome extracts (56.69), turmeric rhizome extracts (76.65), nishindha leaf extracts (66.44), extracts from banyan leaf in cow's urine (86.85) and 100% radial growth inhibition was found in extracts from tobacco leaf in cow's urine, extracts from tobacco leaf and banyan leaf in cow's urine for 24 hours, extracts from tobacco leaf and banyan leaf in cow's urine for 7 days and cows urine. Above 50% radial growth inhibition was found in ginger rhizome extracts (53.51), turmeric rhizome extracts (72.56), nishindha leaf extracts (62.13), extracts from banyan leaf in cows urine (73.92), extracts from tobacco leaf in cow's urine (90.02), extracts from tobacco leaf and banyan leaf in cow's urine for 24 hours (67.58) and cow's urine (95.01) and the 100% radial growth inhibition was observed in extracts from tobacco leaf and banyan leaf in cow's urine for 7 days was observed in 60% concentration. In case of 50% concentration the radial growth inhibition above 50% was observed in turmeric rhizome extracts (71.88), nishindha leaf extracts (51.69), extracts from banyan leaf in cow's urine (67.58), extracts from tobacco leaf in cow's urine (88.66), extracts from tobacco leaf and banyan leaf in cow's urine for 24 hours (55.09) and cow's urine (86.17) and the 100% radial growth inhibition was observed in extracts from tobacco leaf and banyan leaf in cow's urine for 7 days. In case of 40%, concentration above 50% radial growth inhibition was found in turmeric rhizome extracts (70.12),

extracts from banyan leaf in cow's urine (62.36), extracts from tobacco leaf in cow's urine (86.62), extracts from tobacco leaf and banyan leaf in cow's urine for 24 hours (52.15), cow's urine (73.62) and the extracts from tobacco leaf and banyan leaf in cow's urine for 7 days (81.17). Above 50% radial growth inhibition was observed in turmeric rhizome extracts (68.26), extracts from banyan leaf in cow's urine (53.28), extracts from tobacco leaf in cow's urine (69.62), cow's urine (70.07) and the extracts from tobacco leaf and banyan leaf in cow's urine for 7 days (63.62) and in 20% concentration above 50% radial growth inhibition was found in turmeric rhizome extracts (64.62), extracts from tobacco leaf in cow's urine (59.63), cow's urine (51.48) urine and the extracts from tobacco leaf and banyan leaf in cow's urine for 7 days (55.33). The number of spore production was much higher in control condition (1250000) than all the treatments.

In some cases viz. garlic at 30% and 20% concentration, nishindha at 30% and 20% concentration, marigold at 20% concentration and water in banyan leaf at 40%, 30% and 20% concentration the mycelial growth was increased over control (Table2, Table4, Plate3, 5late5, Plate7 and Plate 9, Fig. 3, Fig. 5, Fig. 7 and Fig.11). This was not clear why these happen. In this cases spore formation was found to be reduced distinctly. These results indicated that they have antisporulant effect on *B. sorokiniana*. Here in higher concentration mycelial growth was inhibited but in lower concentration increased radial growth and this effect would be known by chemical analysis of those plant extracts. It can be assumed that radial growth in the initial stage may be lower but when the fungus overcomes the shock of inhibitory effect then radial growth was increased.

Some farmers of Dakope Upazila of Khulna District have been using effectively extracts of tobacco and banyan leaf in cow's urine against insects and diseases instead of chemical pesticides (Nandi, 2007). They keep tobacco leaf and banyan leaf in cow's urine for 7 days and then use this extracts. In this experiment different combination of treatments even cows urine alone was used to justify the information. Tobacco leaf extracts either in cow's urine or in water affects fungal

growth and sporulation although tobacco leaf in cow's urine was the most effective one. Banyan leaf had little effect on *B. sorokiniana* and even in lower concentration growth was found to be encouraged. The results indicated that cow's urine plays a determinant role. Extracts from leaves kept for 7 days in cow`s urine gave better results than for 24 hours which collaborate the practice done by the farmers.

SUMMARY, CONCLUSION AND RECOMMENDATION

SUMMARY, CONCLUSION AND RECOMMENDATION

A research work was carried out for relay cropping at the Experimental Field of Agrotechnology Discipline, Khulna University in Rabi season 2005 to find out the performance of wheat as relay crop in different dates of sowing in Khulna region. The results indicated that different sowing dates had significant effect on plant height (cm), spike length (cm), number of grain per spike, thousand grain weight (g), grain yield (t ha^{-1}), biological yield (t ha^{-1}) and harvest index (%). The highest values for all the parameters were found in 22nd November sowing followed by 30th November sowing except harvest index. On the other hand the higher value of harvest index was found in the treatment of 24th December sowing and the values of other parameters were the lowest. The values of all parameters for 24th December sowing were more or less similar to the other dates of sowing in December. From this result the following conclusions could be made-

1. Late precipitation that increase weed infestation and disease is the main problem for the relay cropping.
2. Early sowing of seed if possible.

For disease control the next experiment was conducted in the Plant Protection Laboratory of Agrotechnology Discipline, Khulna University to evaluate the effect of different plants extracts and cow`s urine at different concentrations (20%, 30%, 40%, 50%, 60%, and 70%) on the growth and spore formation of *B. sorokiniana*, causal agent leaf blight disease of wheat. Different plant extracts and cow's urine at different concentration substantially inhibit the growth and spore formation of *B. sorokiniana*. In all cases, the growth inhibition was found to be increased with the increment of concentration of all the plant extracts and cows urine. Highest growth inhibition was observed in case of tobacco leaf in cow's urine (100%), tobacco leaf and banyan leaf in cow's urine for 24 hours (100%), cow's urine (100%) and tobacco leaf and banyan leaf in cow's urine for 7 days (100%) at 70%. In the case of 60% and 50% concentration the highest growth

inhibition (100%) was found in tobacco leaf and banyan leaf in cow's urine for 7 days (100%). The highest growth inhibition (86.62%) was found in case of 40% concentration in tobacco leaf in cow's urine, in 30% concentration the highest growth inhibition (70.07%) was found in cow's urine and in 20% concentration the highest growth inhibition (64.62%) was found in turmeric rhizome extracts.

At 70%, 60%, 50% 40%, 30% and 20% concentration spore production was hampered in all treatments, although 20%, 30% and 40% concentration in some plant extracts increased growth. From the above result of this experiment it can be concluded that-

1. For all the plant extracts and cows urine higher concentration (70%) was more effective in case of mycelial growth inhibition and spore formation of *B. sorokiniana.*
2. In the specific treatment cows urine tobacco and banyan leaf in cow's urine for 7 days were more effective in case of mycelial growth inhibition and spore formation.
3. Banyan leaf alone has no significant role on the inhibition of mycelial growth and spore formation.

Thus, it was found that cows urine itself or as solvent gives better result in controlling *B. sorokiniana.*

From this study it can be recommended that-

1. The experiment of relay cropping should be repeated. Sowing of wheat should be starting from early November so that; anthesis period could be adjusted with the short winter period in this region.
2. Field trial of the used plant extracts and cow's urine should be conducted.
3. Experiments should be undertaken to know whether there are any detrimental effect of nicotine and cow`s urine.

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