EFFECT OF BION, AMISTAR AND VITAVAX ON SOME FUNGAL DISEASES OF PEANUT

A THESIS

BY

Nazneen Sultana

Examination Roll No. JD-22/2001
Registration No. 16449(Session : 1988 -`89)
Semester : January-June, 2003

MASTER OF SCIENCE

IN

PLANT PATHOLOGY

DEPARTMENT OF PLANT PATHOLOGY
BANGLADESH AGRICULTURAL UNIVERSITY
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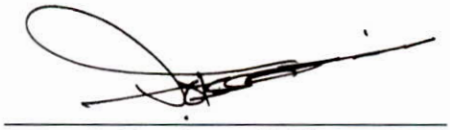

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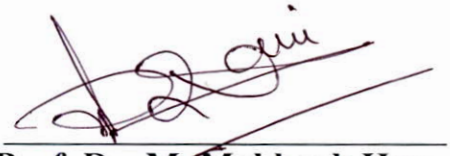

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Dedicated
to my beloved
husband

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The Author

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ABSTRACT

Effect of seed treatment with Bion (Benzothiadiazole), Amistar (azoxystrobin) and Vitavax-200 (Carboxin) on germination, prevalence of seed borne fungi, seedling mortality, tikka disease of peanut var. Dhaka 1 and Jhinga badam were investigated in the laboratory and field laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh during the period of July 2002 to May 2003. Seed health test by blotter method revealed that the seeds of peanut var. Dhaka 1 yielded *Aspergillus niger* (19.0%), *A. flavus* (18%), *Sclerotium rolfsii*(2.33%), *Fusarium* spp. (5.0%), *Rhizoctonia solani* (2%), *Macrophomina phaseolina* (3.0%) and *Penicillium* spp. (1.67%) and seeds of Jhinga badam yielded *Aspergillus niger*(19.3%) *A. flavus* (12.33%), *S. rofsii* (0.67%), *Fusarium* spp. (2.67%), *R. solani* (2.33%), *M. phaseolina* (3.33%) and *Penicillium* spp. (2.0%). Seed treatment with Bion (0.005% and 0.01%), Amistar (0.05% and 0.1%) and Vitavax-200 (0.3% of seed weight) reduced prevalence of seed borne fungi on blotter. Amistar and Vitavax-200 showed best performance in controlling seed borne fungi. Bion (0.01%), Amistar (0.05%) and Vitavax-200 (0.3% of seed weight) completely inhibited the prevalence of seed borne *Sclerotium* and *Fusarium* of peanut var. Dhaka 1 and Jhinga badam. Moreover, Amistar (0.1%) and Vitavax-200 (0.3% of seed weight) strongly inhibited the prevalence of seed borne *Rhizoctonia solani, Macrophomina phaseolina* and *Penicillium* spp. Challenge test with *Aspergillus niger* showed that none of the tested chemicals had the ability to protect crown rot (*Aspergillus niger*) of peanut, whereas Vitavax-200 exerted best performance to control *Sclerotium rolfsii* and increased germination and decreased post emergence seedling mortality. Amistar showed better performance to control *Fusarium oxysporum* and increased germination and decreased post emergence death of seedlings. Vitavax-200 gave better performance and increased germination and decreased post emergence mortality in both the peanut varieties under field condition. Bion showed better performance regarding tikka disease (*Cercospora arachidicola* and *Cercosporidium personatum)* in reducing number of diseased leaflets /plant and incidence of leaf infection at first counting (110 days after sowing). Amistar were found to be effective to reduce number of diseased leaflets/ plant, percent leaf infection and percent leaf area diseased. Bion increased pod yield/plant and kernal yield/plant of peanut var. Dhaka 1 and Jhinga badam by upto 27.06% and 32.33%, whereas Amistar 69.1% and 90.41% and Vitavax- 200, 39.47% and 52.36% over control, respectively.

INTRODUCTION

INTRODUCTION

Peanut (*Arachis hypogaea L.*) is one of the important oil yielding crops in Bangladesh. Peanut belonging to the family Papilionaceae, occupies an important position among all oil seed crops grown in the tropical and sub-tropical countries of the world. In Bangladesh it occupies third place in respect of area, mustard first and sesame second and second place in respect of production (BBS, 2002). Peanut produces the highest oil and protein per unit area (Ahlawal and Chalal, 1986 and BBS, 2002). Its caloric value is 2 to 2.5 times more than that of cereal crops. Peanut seed contains 24-26% protein and 48-52% oil (Khaleque, 1986). It also contains the essential amino acids including cystine. Its seed is an excellent source of B vitamins. It also contains small amount of the vitamin A, C and D. Oil of Peanut is good for cooking which does not contain health deteriorating uracic acid (as in mustard). Moreover, its roots contain numerous nodules which harbour bacteria *Rhizobium* and in association of these bacteria it fixes about 80- 160 kg N/ ha per season (Alam *et al.,* 1988). It is consumed as one of the most popular confectionery items.

In Bangladesh 27000 metric tons of peanut is produced from 64000 acres of land (BBS, 2002). Though it is grown in our country in both kharif and rabi seasons, the production is low compared to the other peanut growing countries of the world. Among the various factors responsible for the low yield of the crop in this country, fungal diseases play a vital role. The world record indicates that peanut has been suffering from 60 different diseases (Westcott, 1947; Mukherji and Basin, 1986) of which 21 are known to occur in Bangladesh (Talukder, 1974; Anonymous, 1983; Ahmed and Hossain, 1985). Different Phytopathogenic soil borne fungi as well as seed borne fungi are responsible for disease development which attack the peanut

plants during seedling to maturity stages. Among the diseases, Seed rot and germination failure (*Aspergillus flavus)*, Crown rot/ collar rot (*Aspergillus niger*), Tikka or leaf spot (*Cercospora arachidicola* and *Cercosporidium personatum*), Wilt (*Fusarium* spp.), Stem rot (*Macrophomina phaseolina*), Dry root rot(*Rhizoctonia solani*) and Foot & root rot (*Sclerotium rolfsii*) are the most common (Fakir, 1980; Reddy *et al.,* 1991; Rao *et al.,* 1997 and Javed *et al.,* 1998).

Management strategies for these diseases include use of disease free seeds, resistant cultivars and chemicals. All approaches are successful but have their disadvantages, such as the brief commercial life of resistant cultivars or occurrence of fungicide resistance (Hayes and Johnston, 1971 and Leadbeater *et al.,* 1997). Induced resistance (IR) is a new technology for crop protection that is assumed to be much more environmentally sound than traditional practices (Sonnemann *et al.,* 2002). Ray (1901) has reported the first descriptions of Induced Resistance. Since then several terms have been used to describe the phenomenon of induced resistance, such as "systemic acquired resistance" (Ross, 1961), "translocated resistance" (Hurbert and Helton, 1967), and "plant immunization" (Tuzan and Kuc, 1991). Induced resistance is the process of active resistance development on the host plant`s physical or chemical barriers, activated by biotic or abiotic agents (Kloepper *et al.*, 1992). Upon irritation of a plant tissue by micro organisms or chemicals, a signal of yet unknown nature is released. This and/or a second signal are then translocated to untreated tissues or plant parts. There it conditions and intensifies a resistance response, when these parts are challenged by plant pathogens (Schloesser, 1997). It was demonstrated that various chemical agents such as salicylic acid (White, 1979), 2, 6- dicloro-isonicotinic acid (Metraux *et al.,* 1991), benzothiadiazole (Goerlach *et al.,* 1996) can induce systemic resistance. Among the various chemicals only few have reached commercialization. The best studied

resistance activator is acibenzolar-S- methyl (Bion). Bion has been released in Europe by Syngenta Ltd., Basel, Switzerland as plant activator Bion (Acibenzolar-S methyl) has a systemic acquired resistance (SAR) effect against several phytopathogens (Cole, 1999; Zeller *et al.*, 1999). Jensen (1997) reported that Amistar was effective against all important cereal pathogens and a new standard for control of net blotch in barley (*Pyrenophora teres*), tan spot (*Pyrenophora tritic repentis)* and glume blotch (*Leptosphaereria nodorum*) in wheat and brown rust in rye (Konradt *et al.*, 1996). Robak and Sobolewski (1997) stated Amistar 250 SC as the most effective fungicide to control plant pathogens. Amistar could control *Pyrenophora tritici repentis* (Konradt *et al.*, 1996 and Jaezewska-kalicka, 1998). Biltrami *et al.* (2002) identified treatments to replace stannic salts for control of Cercospora in beet and observed that optimum rates of Amistar were 0.4 & 0.6 litre/ha. Rideout *et al.* (2002) stated that Amistar could suppress level of Aspergillus crown rot (*Aspergillus niger*) and southern stem rot (*Sclerotium roflsii*). Seed treatment with vitavax was the most effective against *Sclerotium rolfsii* (Yahia *et al.*, 1979; Peshney and Moghe, 1980; Dalvi and Raut, 1987). Shekhawat *et al.* (1986) observed that seed treatment with vitavax could effectively control pre and post emergence collar rot in blotter and pot test. No attempt has yet been made to induce resistance in peanut through chemicals. Therefore, the present study has been undertaken to determine the efficacy of Bion (as inducer), Amistar and Vitavax-200 (as fungicides) to control some diseases of peanut viz. Tikka (*Cercospora arachidicola* and *Cercosporidium personatum*), Crown rot (*Aspergillus niger*), Seed rot (*A. flavus*), Foot and root rot (*Sclerotium rolfsii*) and Wilt (*Fusarium spp*).

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Induced Resistance (IR) is a new technology for crop protection that is assumed to be much more environmentally sound than traditional pesticides. Peanut is subjected to be attacked by different soil-borne as well as seed borne fungal diseases that cause severe losses to peanut production. So, an attempt has been made to review the literature on the effect of Bion (as inducer), Amistar and Vitavax (as fungicides) to peanut against some fungal diseases in inducing resistanc as well as protection of seed.

BION

Ruess *et al.* (1997) reported that Bion 50 WG is the first compound of a new generation of crop protection agents which activate plant defence mechanism called systemic activated resistance (SAR). This plant resistance can be activated by biotic and abiotic agents and results in a systemic protection of the entire plant against a spectrum of diseases caused by fungi and bacteria. They also reported that in cereals, Bion 50 WG at 30 g a.i./ha provides a long lasting protection against *Erysiphe graminis* with a single application at GS 25-32, partial protection against *Septoria spp.* and *Puccinia spp.* They concluded that Bion 50 WG offers an additional, new way in crop protection.

Janczak and Bielecki (1997) reported that Bion 50 is the first compound of a new generation of crop protection agents which activates plant defence mechanism called "systemic activated resistance" (SAR). This particular form of plant resistance can be activated by biotic agents and results in a systemic protection of the entire plant against a spectrum of diseases caused by fungi and bacteria. Bion

50 WG copies this natural biological phenomenon and provides reliable and commercially acceptable protection in several crops against a number of diseases. They conducted two-year trials in 1995-96 in Poland to demonstrate Bion 50 WG performance and they stated that in cereals, Bion 50 WG at 30 g a.i./ha provides a long lasting protection against *Erysiphe graminis* with a single application at GS 25-30.

Schlosser (1997) was presented a paper at a symposium on 'Biotechnology and Plant Protection' at the Sixth Arab Congress of Plant Protection held in Beirut, Lebanon, October 27-31, 1997.He characterized and reviewed Systemic Activated Resistance (SAR) as: resulting from activation of plant defences (not direct pathogen control); having no dose-effect response; requiring an activation period of 2-7 days; a system which can be expressed in plants with no resistance genes for a particular pathogen; affecting biotrophic obligate and non-obligate pathogens; a response which is expressed against all types of the pathogen; a polygenic system of horizontal resistance; and a system which is expressed temporarily, and therefore does not lead to selection of resistance to pathogens. He discussed the use of the benzothiadiazole derivative BION (CGA 245704) for the induction of SAR against fungal and bacterial pathogens with examples.

Schlosser (1997) reported that Benzothiadiazole derivatives (Salicyclic acid and Bion) fulfills all requirements for an inducer of systemic activated resistance (SAR) and had been found to increase resistance against a range of plant pathogenic fungi (*Pseudoperonospora, Phytophthora, Bremia, Blumeria, Erysiphe, Cochliobolus, Magnaporthe, Mycosphaerella, Sclerotinia, Corticum, Puccinia, Alternaria, Colletotrichum*) as well as bacteria (*Pseudomonas, Xanthomonas*).

Laun (1998) explained the mode of action of Bion [benzothiodiazole], via changes in plant biochemistry leading to resistance to pathogens. Study during 1996 in Germany in 15 vegetables showed that treatments with Bion (30 and 60 g/ha in 400 litres/ha water) resulted in crop damage in cucumbers and melons. Studies were also carried out during 1995-97 with Bion (30-60 g/ha, 2-3 times) and Previcur N [propamocarb] in radishes against *Peronospora destructor* and *Albugo candida*. They reported that Bion resulted in better control than the fungicide. The recommended use of Bion in radish is 30 g/ha with intervals of 10 days.

Takacs and Dolej (1998) treated tomato plants infected by *F. oxysporum f.sp. radicis-lycopersici* with the plant activator BION (a product from CIBA GEIGY) at 0.01-1%. They observed that treated plants became less infected with the disease than untreated ones, which indicates the importance of systemically acquired resistance in plant protection, not only in cereals but also in horticultural crops.

Audenaert *et al.* (1999) reported that some non-pathogenic organisms can induce a systemic resistance in plants to pathogen infection. This resistance is called induced systemic resistance (ISR). Several of those microbial agents were tested for their ability to induce resistance in tomato to *Botrytis cinerea* and the role of the bacterial determinant salicylic acid (SA) was studied. As for some strains ISR is depending on the production of SA they also implied BTH (Bion, Novartis) an analogue of SA in this study of ISR. They observed a possible role for SA at the induction site of ISR. They also observed that some SA producing strains, although not all, were able to induce the plant enzyme phenylalanine ammonia lyase (PAL), a key enzyme in the production of lignin, SA and phytoalexins.

Stadnik and Buchenauer (1999) investigated the effect of benzothiadiazole-7-carbothioic acid S-methyl ester (BTH; Bion R) on the autofluorescence responses

of adaxial epidermal cells, activity of phenylalanine ammonia-lyase (PAL) as well as fungal penetration efficiency after challenge of the wheat cultivars Monopol (susceptible) and Zentos (resistant) with *B. graminis f.sp. tritici* (Bgt) [*Erysiphe graminis f.sp. tritici*]. They reported from their results that enhanced PAL-activity and synthesis of autofluorogenic compounds, probably of phenolic nature, are involved in quantitative resistance and in BTH-induced defence mechanisms of wheat plants where they act to inhibit penetration of attacked cells.

Thomson *et al.* (1999) treated Apple and pear seedlings with foliar applications of benzo[1,2,3]thiadiazole-7-carbothioic acid-S-methyl ester (BTH), the active ingredient in the Novartis plant activator Bion (benzothiodiazole), to induce systemic acquired resistance to fire blight caused by *Erwinia amylovora*. Evidence for induced resistance was suggested by enhanced activities of the defense-related peroxidase and glutathione-S-transferase enzymes in those plants protected with BTH but not in the untreated plants.

Zeller *et al.* (1999) stated that the plant activator Bion (Acibenzolar-S-methyl) has a systemic acquired resistance (SAR) effect against several phytopathogens. They tested Bion against fire blight (*Erwinia amylovora*) as a possible alternative to streptomycin. In in vitro studies they found no inhibitory effect against the pathogen but in a bioassay on pear fruit slices bion induced a reduction in exudate production of 63% compared with water treated control. In further experiments under greenhouse conditions with the highly susceptible M26 rootstock Bion treatment resulted in a marked SAR effect. They observed a high decrease of the disease rate of 70% was correlated with a reduction of the bacterial growth up to 60%. Further studies in the field under artificial infection conditions during full bloom with the highly susceptible apple variety James Grieve resulted in a control

effect of Bion up to 68% with 2 concentrations of the compound. They conclude that Bion showed a marked resistance induction effect against fire blight.

Csosz *et al.* (1999) reported that Bion 50 WG is a member of a novel class of inducers of systemic acquired resistance that activates gene expression and disease resistance. They conducted a field trials in 1998 in Hungary in which Bion 50 WG was applied to approx. 50 varieties of wheat to investigate its ability to protect against *Erysiphe graminis f.sp. tritici* and they found that Bion 50 induced greater resistance than triadimefon (as Bayleton 25 WP).

Stadnik and Buchenauer (1999) studied the effectiveness of the resistance inducer BTH (Bion R,benzo(1,2,3)thiadiazole-7-carbothioic acid S-methyl ester [benzothiodiazole]) and fungicides azoxystrobin, cyprodinil and NAD 21100 F with the susceptible wheat cv. Monopol in field trials in Germany over 3 years (1995-97). They observed in their study that BTH-treatment at the end of the tillering stage (GS 28) reduced powdery mildew (*Erysiphe graminis*) severity more effectively than when applied in the middle of tillering stage (GS 25), whereas the earlier application led to higher grain yields. The fungicide cyprodinil (GS 31) controlled powdery mildew and eyespot (*Pseudocercosporella herpotrichoides*) disease more efficiently than BTH, and significantly enhanced grain yield. BTH applications revealed a variable effectiveness against *Septoria tritici* [*Mycosphaerella graminicola*] disease. In contrast, the fungicides azoxystrobin and NAD 21100 F (trifloxystrobin + propiconazole) markedly reduced the disease severity of *M. graminicola*. They found that all tested fungicides increased grain yield of wheat, combinations of BTH with fungicides did not show any additional effect on yield, although sometimes a stronger reduction of the foliar diseases was observed.

Keller (1999) reported that resistance against plant diseases can be increased by the activation of the signal for natural plant defences at cell level or by 'genetic vaccination'. However, many molecules produced by pathogenic microorganisms are also important for the activation of the natural plant defence mechanism. They described that the cellular signals can be activated by the presence of salicylic acid and the use of this mechanism in Bion.

Cole (1999) reported that Acibenzolar-S-methyl (ABM), a benzothiadiazole, is a novel plant protection product that mimics the pathogen-host interaction and results in systemic acquired resistance in plants. The author treated 2.7 and 4.7% of the tobacco seedlings had symptoms 9 weeks after transplanting with ABM and ABM + copper oxychloride, respectively and 72% of the unsprayed. They observed that natural infection of Rhizoctonia leaf spot (*Thanatephorus cucumeris*) was less prevalent on plants sprayed with ABM.They also observed that seedbed-sprayed only and seedbed plus 2 field sprays of ABM reduced the incidence of frogeye leaf spot on field plants and the amount of barn spot (both caused by *Cercospora nicotianae*) in the coloring phase of leaf curing and the yield and quality were not adversely affected by ABM.

Jackel and Schmidt (2000) evaluated 24 plant tonics in 100 field trials with vegetables and ornamentals and carried out by the Berlin Plant Protection Office over several years. They observed some pest control (ENVIRepel) and yield-promoting effects (Bion on tomatoes and Goemar on strawberries) which were not harmful to beneficial soil organisms .

Firoz and Hossain (2000) observed that Bion showed good result as a SAR inducers against some major diseases of rice cultivars BR 11 and BRRI Dhan 32 and increased yield by 40.46% and 9.55% respectively.

Zahid *et al.* (2000) applied Foliar sprays of potassium phosphonate (0.1 g a.i./litre or 1.0 g a.i./litre) and Bion 500 WG (500 g/kg acibenzolar-S-methyl; 1.0 g a.i./litre or 2.5 g a.i./litre), separately and in combinations, to *Pinus radiata*, *Banksia integrifolia* and *Isopogon cuneatus* plants immediately after transplanting into potting mix infested with *P. cinnamomi*. After 14 weeks the incidence of root infection by *P. cinnamomi* was assessed and plant growth measured. They observed that incidence of root infection was reduced by sprays of potassium phosphonate or Bion. They also reported that combinations of phosphonate and Bion additively reduced the incidence of root infection, but no treatment eradicated the pathogen from roots or soil.

Pecze and Kurtz (2000) summarized the results of investigations in Hungary since 1997 on the use of the resistance activator Bion 50 WG in various varieties of winter wheat in relation to resistance to several plant diseases.

Sokolova *et al.* (2001) investigated the influence of plant growth regulators (PABA [p-aminobenzoic acid], ambiol, bion, ivin, immunocytofit, cholin chloride and F-760) on the toxinogenesis of the plant pathogenic fungi *Fusarium graminearum* [*Gibberella zeae*]. They applied plant growth regulators to the nutrient medium at concentrations of 10-3-10-8 M. They observed that Ambiol increased the production of fungal toxins (deoxynivalenol and 15-acetyldeoxyvalenol) by 3-20 times compared to that in the control, with minimum action at 10-6 M. Bion and choline chloride inhibited toxinogenesis at 10-6-10-5 M, but activated it at lower or higher concentrations. Ivin, PABA and F-760 suppressed the formation of toxins at all concentrations. Immunocytofit increased toxin production at 10-7-10-8 M.

Ratnam *et al.* (2001) investigated the effect of seed treatment with inducer chemicals (salicylic acid and Bion) on the systemic resistance of sunflower to *A. helianthi*. They observed that the systemic resistance of sunflower was induced by salicylic acid and Bion. They reported that Bion was more effective than salicylic acid in the induction of resistance.

Czaplicki (2001) reported that Bion 50 WG (a resistance stimulator to be applied to cereals and tomatoes, mainly against powdery mildew); Command 360 CS (clomazone, a herbicide to be applied in tank-mixtures with other herbicides for potatoes and winter rape); Cougar 600 SC (diflufenican + isoproturon, a herbicide to be applied in winter cereals, lettuce, ornamentals and in the nurseries of forest trees); Super Homai 70 DS (thiophanate-methyl + thiram) -- introduced for use on tulip bulbs; Jockey 201 FS (fluquinconazole + prochloraz) introduced for winter wheat, winter triticale and rye against snow mould; Sadoplon 75 WP (thiram) introduced for control of several diseases of raspberry and strawberry; and Carat 350 SC (diflufenican + flurtamone) -- the recommendations for weed control in winter wheat, winter barley, winter triticale and rye have been changed.

Eikemo *et al.* (2002) tested five different compounds as putative elicitors of disease resistance to *P. cactorum* causing crown rot in strawberry. Three of the compounds were chemical products (BionTM, AlgifertTM and chitosan) and two were biotic (spores or crushed, autoclaved mycelium of *Trichoderma harzianum*). Cold-stored strawberry plants of two cultivars (Korona and Zephyr) were grown for two weeks in the greenhouse prior to treatment with the putative elicitors. Two or three days later, they inoculated plants with a zoospore suspension of *P. cactorum*. They observed that two of the putative elicitors had a positive effect on the degree of disease development. They reported that Chitosan or Bion reduced the disease score for both cultivars, but in varying degrees, depending on concentration and

addition of Triton X-100. The other four putative elicitors had no or only slight effects on disease resistance.

Hossain (2002) studied the compatative efficacy of Bion, Amistar and Tilt for controlling Brown spot (*Bipolaris oryzae*) and Narrow brown spot (*Cercospora oryzae*) of rice cv. BR 11. He sprayed Bion at 50mg/L, Amistar at 1ml/L and Tilt 1ml/L at tillering and ear initiation stage and observed that Bion showed marked effect at ear initiation stage in reducing brown spot and narrow brown spot and increased grain yield.

Rahman (2002) treated seeds of chilli with Bion, Amistar & Vitavax and observed that plants raised from bion treated seeds did not show die back of chilli and percent leaf area damage of leaf was always less compaired to other treatments i.e.Amistar and Vitavax.

Sandri (2002) applied Bion MX (a mixture of CGA 245704 (Bion) + metalaxyl-methyl) at 250 g/ha on Virginia Bright tobacco cv. K394 (sensitive to *Peronospora tabacina*). Bion MX was compared with Ridomil Gold MZ (metalaxyl-methyl + mancozeb) and Ridomil MZ (metalaxyl + mancozeb). They applied after transplanting tobacco, and observed bion MX reduced the presence of the disease by around 50%.

Sonnemann *et al.* (2002) stated that Induced resistance (IR) is a new technology for crop protection that is assumed to be much more environmentally sound than traditional pesticides. They induced resistance by applying the plant activator BION(R) to barley and fallow plots. They studied soil biota by measuring a broad range of microbiological and zoological parameters. They observed that BION(R) treatment significantly reduced the growth of barley roots and increased root infection by the parasitic nematode Pratylenchus, but did not cause measurable

changes in plant productivity, in the composition of the free-living soil biota or in root infection by mycorrhizal fungi. They stated that strong reduction of root biomass and selective effects on root-associated soil biota might have long-term effects on ecosystem functioning.

AMISTAR

Konradt *et al.* (1996) reported that amistar was effective against all important cereal pathogens and a new standard for control of net blotch in barley (*Pyrenophora teres*), tan spot (*P. tritic-repentis*) and glume blotch (*Leptosphaeria nodorum*) in wheat and brown rust in rye.

Jensen (1997) reported that Amistar had been developed in Denmark primarily for control of cereal diseases. He observed good control of a wide range of pathogens resulted in increased yields with improved grain quality in terms of 1000-grain weight and size.

Robak and Sobolewski (1997) stated Amistar 250 SC (azoxystrobin) as the most effective fungicide to control plant pathogens was which provided levels of disease control equivalent to or better than current commercial standards. They found that Amistar 250 SC was effective against cucumber downy mildew, cucumber powdery mildew, downy mildew on onion and late blight on tomato at the rate of 0.8 litre/ha of product.

Wittouck (1997) tested fungicides to control ear disease of winter wheat occurred in Belgium in the summer of 1997 and observed that 250 g azoxystrobin/litre (as Amistar) at 1 litre/ha, or 125 g expoxiconazol + 125 g kresoxim-methyl/litre at 1 litre/ha (as Allegro) were the most effective for disease control.

Jaczewska-Kalicka (1998) applied new fungicides (propaquizafop (as Falcon 460 EC), Brio 450 SL, azoxystrobin (as Amistar 250 SC), 4-bromo-2-(4-chlorophenyl)-1-(ethoxymethyl)-5-(trifluoromethyl)-1H-pyrrole-3-carbonitrile (as Alert 375 SC) and prochloraz (as Sportak 45 EC)) during 1996-97, to wheat fields in Chylice, Poland and found that these fungicides could control *Septoria spp.*, *Pyrenophora tritici-repentis*, *Erysiphe graminis* and *Pseudocercosporella herpotrichoides* mean increase of yield was 12.8%.

Robak (1998) found that Diethiofencarb + carbendazim (as Sumico 50 WP) and azoxystrobin (as Amistar 250 SC) gave the best control of *Botrytis cinerea* on white cabbage during storage compared with iprodione (as Rovral Flo 255 SC) and dichlofluanid (as Euparen 50 WP). They observed that applications of azoxystrobin and propineb (as Antracol 70 WP) significantly reduced Alternaria leaf spot on Chinese cabbages growing in the field in Poland.

Skrzypczak and Orlikowski (1998) found that weekly spraying of Goniolimon tataricum with Amistar 250 EC (250 g of azoxystrobin/l) at concentrations of 0.05-0.15% significantly decreased the spread of downy mildew caused by *Peronospora statices*. They also found that Azoxystrobin inhibited the formation and germination of *P. statices* spores on leaves while, Azoxystrobin added into PDA medium at 1000 æg/ml completely inhibited mycelial growth of *Phytophthora cryptogea*. Spraying of plants with azoxystrobin decreased at least 50% of Phytophthora foot rot development.

Skrzypczak and Fiedorow (1998) reported that weekly spraying of Goniolimon tataricum with 250 g/litre azoxystrobin (as Amistar 250 EC) at 0.05-0.15% can significantly decrease the spread of downy mildew (caused by *Peronospora statices*). They observed that Azoxystrobin inhibited formation of *P. statices* spores

on leaves and their germination in vitro. In comparison with unsprayed plant 84-94% less spores were produced on leaves treated with azoxystrobin.

Hellemann (1999) tested 13 cultivars several fungicides for susceptibility to infection of Septoria in wheat in Denmark in 1998. They found that susceptibility was low in cultivars Terra, Cortez, SJ 977696 and Stakado, while Folicur [tebuconazole] and Amistar [azoxystrobin] were effective fungicides.

Jensen (1999) studied grain quality in relation to fungicide treatment of cereals. He observed that the yield increase was higher with the new strobilurin Amistar TM (azoxyatrobin 250 g/L) compared to the old standard (Propiconazole & fenpropimorph mixtures). Amistar was found to positively influence yield, thousand-grain weight, hekto-litre-weight, sieving fraction and nitrogen utilization.

Orlikowski and Marasek (1999) conducted trials in Poland in summer 1998, and observed that one or two sprays of willow (Salix caprea 'Pendula'), naturally infected with *Melampsora epitea* with Amistar 250 EC (250 g of azoxystrobin per 1 dm3) drastically decreased the development and spread of the pathogen.

Hessenauer and Glaser (2000) conducted a trial at the state institute for plant protection at Stuttgart during 1997-99 to evaluate the rust (*Melampsora hypericorum* and *Uredo hyperici*) resistance of 10 Hypericum varieties and the effectiveness of different fungicides. They reported that preventive treatments with Amistar (azoxystrobin) and Bardos Neu (difenoconazol) kept plants disease-free.

Jorgensen (2000) conducted a trial during 1999 in Denmark and used 0.5 l/ha of Amistar [azoxystrobin] alone or Amistar+Folicur [tebuconazole] and reported that a mixture of tebuconazole and azoxystrobin could provide a broad and good control treatment against Fusarium ear blight.

Weber and Karolewski (2000) studied the effect of different fungicides on *Pyrenopeziza brassicae* infecting various oilseed rape cultivars (Mar and Silvia) in 2 field experiments. They treated Mar with Alert 375 SC (4-bromo-2-(4-chlorophenyl)-1-(ethoxymethyl)-5-(trifluoromethyl)-1H-pyrrole-3-carbonitrile), Alto 320 SC (cyproconazole), Amistar 250 SC (azoxystrobin), Benlate 50 WP (benomyl) and Discus 500 WG (50% kresoxim-methyl); and Silvia was treated with Alert 375 SC and Caramba 60 SL (metconazole). They reported that application of fungicides in autumn (when the symptoms were not observed) was often more efficient in the control of light leaf spot on Mar (susceptible to *P. brassicae*) and on the less susceptible cultivar, Silvia, the application of fungicides in spring and autumn was found to be similar efficacy.

Firoz (2001) sprayed a single dose of Bion (50mg/L), Amistar (1ml/L), Tilt (1ml/L), Bion + Amistar [(50mg+1ml)/L] and Bion + Tilt [(50mg+1ml)/L] to rice plant before a week of ear initiation. He observed that Tilt and Amistar gave the highest grain yield of rice cultivars BR11 and BRRI Dhan 32.

Willingham *et al.* (2001) found that Strobilurin fungicides were effective in controlling postharvest diseases of 'Hass' avocado. They tested three strobilurin formulations in the field (in Queensland, Australia) on 'Hass', the Amistar and Flint fungicides were found to be superior to the Stroby formulation. They reported that the incidence of anthracnose (caused by *Colletotrichum gloeosporioides* [*Glomerella cingulata*]) was significantly reduced by 66 or 74% when Amistar or Flint was applied as a foliar spray.

Beltrami *et al.* (2002) conducted trials in 2001to identify treatments to replace stannic salts for control of Cercospora in beet. They used various rates of azoxystrobin (as Amistar) combined with 0.25 litre difenoconazole/ha (as Score 25

EC) and observed that optimum rates for Amistar were 0.4 and 0.6 litre/ha. They reported that a rate of 0.8 litre/ha had no advantage over 0.6 litre/ha, and 0.2 litre/ha proved inadequate.

Hossain (2002) sprayed Bion (5mg/L), Amistar (1ml/L) and Tilt (1ml/L) to rice cultivar BR 11 at tillering and ear initiation stage and observed that Amistar showed good fungicidal effect in controlling Brown spot and Narrow brown spot. He also observed that Amistar treated plants gave the highest yield when Amistar sprayed at tillering stage.

Rideout *et al.* (2002) conducted two experimental trials in Georgia, USA, both in 2000 and 2001 and observed that applications of azoxystrobin in-furrow have shown inconsistent results in terms of yield and disease control in peanut plots. Treatments included: azoxystrobin in-furrow alone (102 g a.i./ha), azoxystrobin mid-season alone (two applications at 335 g a.i./ha), azoxystrobin both in-furrow and mid-season, and a nontreated control. They found that in-furrow treatment of azoxystrobin had minimal impact on plant stand counts, tomato spotted wilt incidence, yield and crop value. However, they reported that in-furrow applications of azoxystrobin did suppress levels of Aspergillus crown rot (*Aspergillus niger*) and early season (prior to 60 days after planting) southern stem rot (*Sclerotium rolfsii* [*Corticium rolfsii*]).

Wicks and Hitch (2002) evaluated the strobilurin fungicides Amistar (azoxystrobin) and Flint (trifloxystrobin) in 1999-2000 and 2000-2001 in programmes that included various combinations with Thiovit (sulfur) and Topas (penconazole) for the control of powdery mildew (caused by *Uncinula necator*) on grapes. In programmes they directly compared the application of Amistar and Flint and observed that Flint was the most effective fungicide for controlling powdery

mildew. In the experiments where downy mildew also developed, Amistar was more effective than Flint in controlling this disease.

Rideout *et al.* (2002) conducted two experimental trials in Georgia, USA, both in 2000 and 2001 and observed that applications of azoxystrobin in-furrow have shown inconsistent results in terms of yield and disease control in peanut plots. Treatments included: azoxystrobin in-furrow alone (102 g a.i./ha), azoxystrobin mid-season alone (two applications at 335 g a.i./ha), azoxystrobin both in-furrow and mid-season, and a nontreated control. They found that in-furrow treatment of azoxystrobin had minimal impact on plant stand counts, tomato spotted wilt incidence, yield and crop value. However, they reported that in-furrow applications of azoxystrobin did suppress levels of Aspergillus crown rot (*Aspergillus niger*) and early season (prior to 60 days after planting) southern stem rot (*Sclerotium rolfsii* [*Corticium rolfsii*]).

VITAVAX

Yahia *et al.* (1979) tested fungicides in vitro against *Sclerotium rolfsii.* Seed treatment with Benlate [benomyl], Vitavax [carboxin]/thiram and Vitavax/captan, and soil treatmentwith Brassicol-75 [quintozene] reduced damping off and root rot of peanut in the field.

Peshney and Moghe (1980) conducted tests on 21 fungicides against an isolate of *Sclerotium rolfsiii* from peanut. They reported that the most effective inhibition of sclerotial germination and mycelial growth was given by Derosal [carbendazim], formaldehyde, Vitavax [carboxin] and Planvax [oxycarboxin].

Shekhawat *et al.* (1986) observed that Carbendazim, benomyl, carboxin and ethyl mercury chloride were the most effective of 11 fungicides against *A. niger* in vitro

at 1500 p.p.m. They also effectively controlled pre- and post-emergence collar rot in the blotter and pot tests when used as seed dressing at 2-2.5 g/kg seed.

Dalvi and Raut (1987) evaluated 6 fungicides in vitro as seed dressings and observed that Vitavax [carboxin], Hexathir [thiram], Hexacap [captan] and Emisan-6 gave effective control of *Sclerotium* [*Corticium*] *rolfsii* in pot experiments.

Bansal and Sobti (1988) dressed M-13 peanuts seeds with 6 fungicides (Bavistin [carbendazim], Blitox-50 [copper oxychloride], Brassicol [quintozene], Dithane M-45 [mancozeb], thiram and Vitavax [carboxin]) and incubated at 28 ñ 1øC for 6 d and they observed that all fungicide treatments except copper oxychloride and quintozene significantly reduced infection by *A. flavus*. They reported that Thiram completely eradicated seedborne infection of *A. flavus* and gave the highest percentage seed germination and percentage seed germination improved with all treatments except carboxin.

Nagar *et al.* (1990) observed that the incidence of crown rot of peanuts in soil infected by *Aspergillus niger* was reduced when the seed was treated with Vitavax [carboxin], captan and/or benomyl and inoculated with *Rhizobium lupini*. They stated that soil infestation with the pathogen reduced peanut growth parameters while the presence of *R. lupini* improved them.

Nofal *et al.* (1990) treated peanut seed with Vitavax [carboxin] + captan at 3 g/kg seed and sprayed growing plants with Benlate [benomyl] at 2.5 g/litre. They observed that these treatments significantly reduced crown rot (A. niger) incidence and was followed by an increase in FW and DW, shoot and root length, number of branches, leaves and nodules and yield. Different treatments with the fungicides decreased the number of *Aspergillus niger* and other microbial counts in the rhizosphere of treated plants. They also observed that combining carboxin + captan

seed treatment and benomyl spray 3-4 times during the growing period gave the best disease control.

Hilal *et al.* (1990) evaluated in trials in Egypt, 5 seed dressing fungicides alone or in combination with *Rhizobium lupine* for control of soilborne peanut diseases. They found that plant survival was increased most following treatment with Bavistin [carbendazim] or Sumisclex [procymidone], followed by Benlate [benomyl]. Vitavax [carboxin] + captan was the least effective treatment. Seed or soil application of Rhizobium also increased plant survival, with no significant differences between treatments. They reported that all fungicides tested effectively reduced the incidence of brown rot (*Rhizoctonia solani*), pink rot (*Fusarium moniliforme* [*Gibberella fujikuroi*]) and rots caused by various other pathogens, although Bavistin and Sumisclex were the most effective.

Emmimath (1994) treated peanuts cv. JL-24 seeds with *Aspergillus flavus* and brassicol [quintozene], Blitox-50 [copper oxychloride], bavistin [carbendazim], dithane M-45 [mancozeb], thiram or vitavax [carboxin] or not treated with fungicides. They found that except for brassicol, the fungicide treatment decreased *A. flavus* growth, in particular thiram which completely controlled fungus, and as a result improved percentage germination, decreased damage to seeds and increased seedling vigour.

Awad *et al.* (1994) conducted a field experiments at El-Esmailia, Egypt, in 1991-92. They treated ground nuts seeds with or without vitavax [carboxin] in combinations of trace elements. They obtained the highest pod yield with Zn + Mn + Fe + Cu + B and the highest seed yield with Zn + Mn + Fe + Cu + B + Mo. And they observed that Vitavax showed adverse effects on peanut yield and yield components with the exception of 100-seed weight which increased.

Das *et al.* (1999) evaluated eight commonly available fungicides, Bavistin (carbendazim), Topsin-M (thiophanate-methyl), Blitox-50 (copper oxychloride), Indofil M-45 (mancozeb), thiram, Vitavax (carboxin), Foltaf (captafol) and Kavach (chlorothalonil), in vitro at 3 concentrations against *L. crassiasca* inciting pepper spot and leaf scorch disease of peanut. They found that Carbendazim was the most effective fungicide, inhibiting 100% mycelial growth of the fungus at all 3 concentrations tested (0.05, 0.1 and 0.15%). The next in order of efficacy was thiophanate-methyl followed by thiram; both of these fungicides completely checked the growth of the fungus at their recommended concentrations and Carboxin was the least effective fungicide.

Patibanda *et al.* (2002) conducted a study to determine the feasibility of using *T. harzianum* alone or in combination with fungicides for the management of sclerotium wilt in peanut. They observed that *T. harzianum* application either to soil as wheat bran saw dust (WBSD) preparation or on the peanut seeds as spore coat proved effective against sclerotium wilt caused by *Sclerotium rolfsii* [*Corticium rolfsii*]. They also observed synergistic and positive effects on disease control when *T. harzianum*-WBSD preparation was applied to soil in integration with Vitavax [carboxin] or Vitavax-200. Integration of Thiram (seed coating) and soil application of antagonist was found compatible and synergistic.

MATERIALS AND METHODS

MATERIALS AND METHODS

3.1. Experimental Site

The experiments were conducted both in the laboratory and under field condition. In-vitro studies were done in Seed Pathology Center (SPC) and Laboratory of the Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh. Field experiment was conducted in the field laboratory of Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh.

3.2. Experimental Period

The experiments were conducted during the period of May 2002 to June 2003.

3.3. Variety of peanut

Two varieties of peanut (*Arachis hypogaea L*) namely Dhaka-1 (Maizchar badam) and Jhinga badam (Acc-12) were used.

3.4. Collection of seeds

Seeds were collected from Bangladesh Agricultural Development Corporation (BADC), Kustia.

3.5. Laboratory Experiment

3.5.1.Detection and identification of seed borne fungi of peanut

A composite sample of each variety was assayed for the presence of seed borne fungi by following Standard Blotter Method (ISTA, 1996). In this method, three pieces of 9 cm filter paper (Whatman filter No. 1) were dipped in distilled water and placed at the bottom of the plastic petridish (9 cm dia.). 200 seeds (unshelled) from each of the samples were taken randomly and then placed on the moist filter

paper in 20 petridishes at the rate of 10 seeds per plate in three replications. The petridishes with seeds were then incubated at 12/12 hours alternating cycles of Near Ultraviolet (NUV) light and darkness in the incubation room of the Seed Pathology Center (SPC), BAU, Mymensingh for 14 days. After incubation, the seeds were examined for the presence of seed borne fungi and identified by observing their growth characters on the incubated seeds on blotter under stereomicroscope at 25x magnification following the keys of Ramnath *et al.* 1970 and Khan, 1975. In case of doubtful for identification under stereomicroscope, temoprary slides were prepared and examined under the compound microscope and identified (Booth, 1971; Ellis, 1993; Mathur and Kongsdal, 1994). Numbers of germinated seeds were recorded along with the seed borne fungi. The germination and incidenc of seed borne fungi were expressed in percentage.

3.5.2. Chemicals used

Three chemicals namely Bion (Benzothiadiazole), Amistar (Azoxystrobin) and Vitavax-200 (Carboxin) were used.

3.5.3. Treatments

T_1=Control (untreated)

T_2=Bion (0.005%)

T_3=Bion (0.01%)

T_4=Amistar (0.05%)

T_5=Amistar (0.1%)

T_6=Vitavax-200 (0.3% of seed weight.)

3.5.4. Seed treatment with Bion, Amistar and Vitavax-200 and evaluation of their efficacy in controlling seed borne fungi

Blotter method

Seeds of Dhaka-1 and Jhinga badam varieties were used for the seed treatment. 200 seeds of each selected samples were dipped for 6 hours in the chemical solutions Viz. Bion at 0.005%, Bion at 0.01%, Amistar at 0.05%, Amistar at 0.1% separately and in water for the control treatment Vitavax-200 at 0.3% of seed weight was used as dry seed treatment. The treated seeds were plated on moistened filter paper at the rate of 10 seeds per plate. The test was carried out following the method of International Rules for Seed Health Testing (ISTA,1996). The petridishes with seeds were then incubated at 20 ± 2^0 C, 12/12 hours alternating cycles of Near Ultraviolet (NUV) light and darkness in the incubation room of the Seed Pathology Center (SPC), BAU, Mymensingh for 14 days. After incubation period the seeds were examined under stereomicroscope for detecting the fungi grew over the germinating seeds on blotter. Numbers of germinated seeds were recorded along with the seed borne fungi. The germination and incedenc of seed borne fungi were expressed in percentage.

3.6. Germination test

3.6.1. Seed treatment with Bion, Amistar and Vitavax-200 on germination of peanut in Blotter

This test has been done following the same procedure as done in case of 3.5.4.

3.6.2. Seed treatment with Bion, Amistar and Vitavax-200 on germination of peanut seeds on water agar slants

In this method water agar slants were prepared in test tubes pouring 10 ml melted water agar per test tube. Seeds of each selected samples were dipped for 6 hours in chemical solution of Bion at 0.005%, Bion at 0.01%, Amistar at 0.05% and Amistar at 0.1% separately and in water for the control treatment. Vitavax -200 at 0.3% of

seed weight was used as dry seed treatment. The treated seeds were placed on water agar slants (one seed per test tube), where 200 seeds were tested in each treatment in three replications. The test tubes were then kept on racks for incubation in challenge chamber at room temperature of the Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh. After 21 days of incubation data were collected on seed germination.

3.6.3. Seed treatment with Bion, Amistar and Vitavax-200 on germination of peanut seeds on PDA slants

This study was carried out following the same procedure as of section 3.6.1. where PDA instead of water agar was used. After 21 days of incubation data were collected on germination.

3.7. Challenge test

3.7.1. Isolation and preservation of *Aspergillus niger* from seed

Seeds of peanut were plated following the Blotter method (ISTA, 1996). After incubation *Aspergillus niger* was isolated form the seed surface with a sterilized needle and then was transferred to acidified (PDA) plates. The plates were incubated at room temperature for 7 days and observations were made regularly to see the growth of *Aspergillus niger*. The fungus that grew over PDA was reisolated and purified (Fig.1). The pure culture of *Aspergillus niger* was preserved in PDA slant at 5+1^{0}C in refrigerator as stock culture for future use.

3.7.2. Isolation and preservation of *Sclerotium rolfsii* from diseased plant

Isolation of *Sclerotium rolfsii* from diseased plants of peanut was accomplished by tissue planting method (Fig. 2). Specimens having typical symptoms of foot and root rot were collected from the experimental field. Diseased specimens were collected using the polythene bag and brought immediately to the laboratory of the

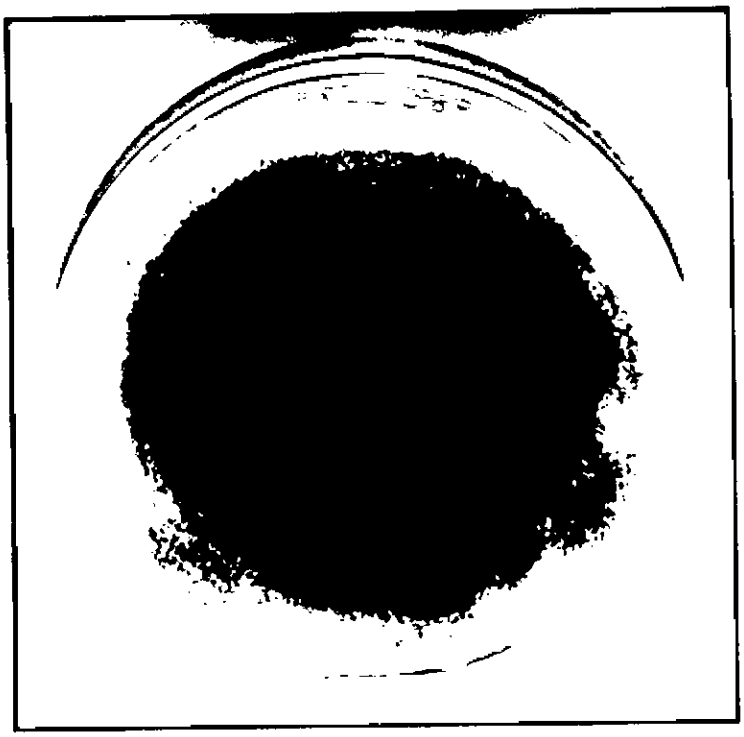


Fig. 1. Culture of *Aspergillus niger* (on PDA)

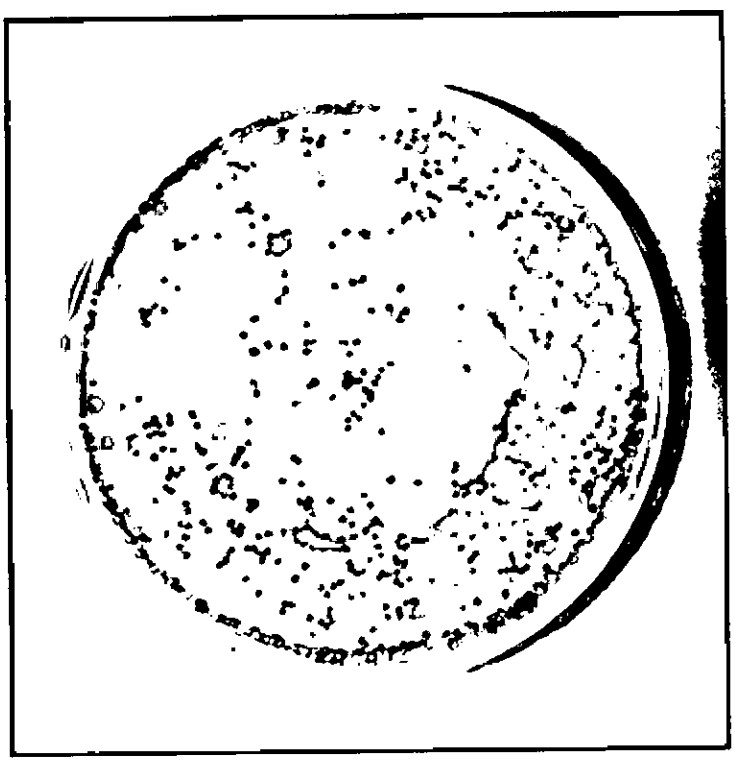


Fig. 2. Culture of *Sclerotium rolfsii* (on PDA)

Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh. The diseased samples were then washed in tap water to remove sand and soil particles. Thereafter, the specimens were cut into small pieces (1.0cm) having healthy and dead tissues and surface sterilization was done with mercuric chloride solution (1: 1000) for 1 minute. The pieces were then washed thoroughly with sterilized water thrice and placed on filter paper to remove excess water adhering with the pieces. The pieces were then placed on moist chamber and incubated at room temperature for 7 days. After incubation the fungus that grew over the diseased specimen was isolated with a sterile needle and transferred to acidified PDA plates. Thereafter, the fungus that grew over PDA was isolated and purified. The isolated fungus was identified following the key outlined by Booth (1971) and Singh (1982). The pure culture of *Sclerotium rolfsii* was preserved in PDA slants in the refrigerator as stock culture for future use.

3.7.3. Isolation and preservation of *Fusarium oxysporum* from diseased specimen of peanut collected from the field

Isolation of *Fusarium oxysporum* from seeds of peanut was accomplished by tissue planting method (Fig. 3). Specimen having typical symptoms of pre-emergence death and seed rot were collected from the experimental field. Diseased specimens were collected using the polythene bag and brought immediately to the laboratory of the Department of Plant Pathology, BAU, Mymensingh. The diseased samples were then washed in tap water to remove sand and soil particles. There after, the specimens were cut in to small pieces (1.0) cm having healthy and dead tissue and surface sterilization was done with mercuric chloride solution (1: 1000) for 1 minute. The pieces were then washed thoroughly with sterilized water thrice and placed on filter paper to remove excess water adhering with the pieces. The pieces

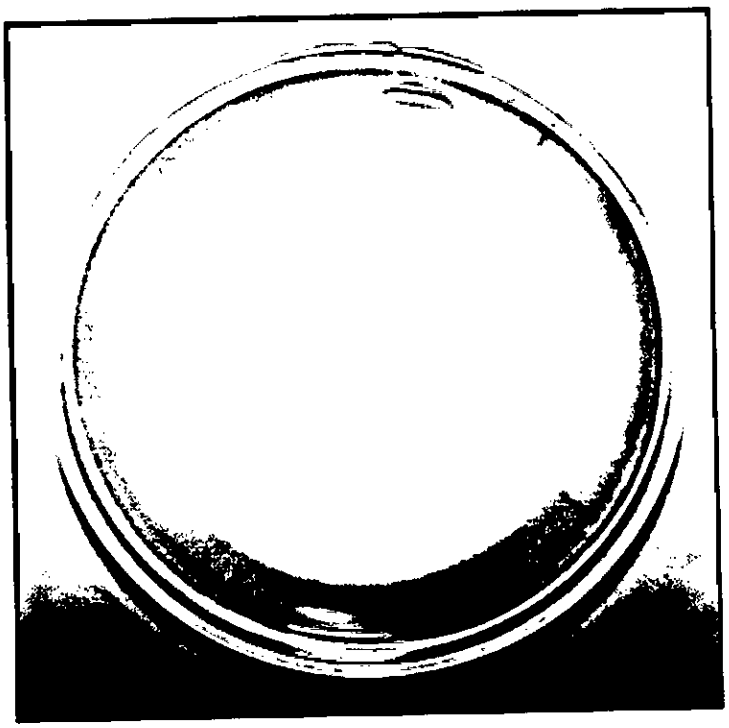


Fig. 3. Culture of *Fusarium oxysporum* (on PDA)

were then placed on moist chamber and incubated at room temperature for 7 days. After incubation the fungus that grew over the diseased specimen was isolated with a sterile needle and transferred to acidified PDA plates. Thereafter the fungus that grew over PDA was isolated and purified. The isolated fungus was identified following the key outlined by Booth (1971). The pure culture of *Fusarium oxysporum* was preserved in PDA slants in the refrigerator as stock culture for future use.

3.7.4.1. Challenge test of *Aspergillus niger* to treated seeds on PDA slants

Seeds of each selected samples were dipped for 6 hours in chemical solution of Bion at 0.005%, Bion at 0.01%, Amistar at 0.05% and Amistar at 0.1% separately and in water for the control treatment. Vitavax -200 at 0.3% of seed weight was used as dry seed treatment.10 seeds of each variety (9 seeds/ replication) were treated as per treatment and were placed on PDA slants (one seed/slant). Mycelial blocks (5 mm dia.) were cut from 7 days old culture of test pathogen and were placed at PDA slant attached to the seed surface. The slants were then incubated at room temperature for a period of 21 days. After incubation data were recorded on germination, seed deterioration and post emergence death of seedlings.

3.7.4.2. Challenge test of *Sclerotium rolfsii* to treated seeds plated on PDA slants

This test has been done following the method as done in case of challenge test of *Aspergillus niger.*

3.7.4.3. Challenge test of *Fusarium oxysporum* to treated seeds plated on PDA slants

This test has been done following the same procedure as done in case of challenge test of *Aspergillus niger* to treated seeds.

3.8. Field experiment

3.8.1. Experimental site

The experiment was conducted in the field laboratory of the Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh.

3.8.2 Soil condition

The soil of the experimental site belongs to the non-calcareous Grey flood plain under the Agro-Ecological Zone (AEZ) of old Brahmaputtra Alluvial soil. The land was medium high land and soil texture was sandy loam with P^H 6.5-6.8 (Ramans and Ali, 1970).

3.8.3. Experimental period

The experiment was conducted during the period of December 2002 to May 2003.

3.8.4. Materials

Seed samples of peanut variety Dhaka 1 and Jhinga badam were collected from Bangladesh Agricultural Development Corporation (BADC), Kustia.

3.8.5. Seed treatement with Bion, Amistar and Vitavax –200

Seeds of each variety were treated with Bion, Amistar and Vitavax-200 as per treatment as shown in 3.5.4.

3.8.6. Land preparation

The soils of experimental plots were opened with tractor in November 2002. weeds and other rubishes were removed. The final ploughing and laddering was done

using country plough. The plot was then prepared according to experimental design in the first week of December, 2002. No manures and fertilizers were applied in the field.

3.8.7. Experimental design and layout

The field experiment was conducted in Randomized Block Design (RBD). The size of the individual plot was 2.5 m × 5 m with spacing 50 cm between plots.

3.8.8. Sowing of treated seeds in the fields

The treated seeds were sown in line about 2 cm depth and immediately the seeds were covered with soil. The line to line and plant to plant distances were 40 cm and 20 cm, respectively (DAE, 1985). The seeds were sown in the field in the afternoon on December 16, 2002.

3.8.9. Intercultural operation

Weeding were performed at 15 days intervals. Three times insecticides were applied to control hairy caterpillar and Jassids. Nogos 100 EC @ 0.1% was sprayed on 22 January, 2003 and 15 February, 2003 and Diazinon 60 EC was sprayed on 7 April, 2003.

3.8.10.Field Inspection

The experimental plots were inspected regularly to observe incedence of different diseases including post emergence seedling death.

3.8.11.Assessment of Leaf spot/Tikka disease severity

10 plants from each unit plot and 12 leaves (leaves from upper, middle and lower) of each plant were randomly selected for counting the number of healthy and diseased leaves, severity of disease intensity. During data collection too younger and too older leaves were discarded. Disease severity of those randomly selected

leaves of each plot was assessed by counting percent leaf area infected. This was done three times starting from 110 days after sowing with an interval of 10 days.

3.8.12.Harvesting and recording pod yield

Plants were harvested after 157 days of sowing. The plants of each plot were carefully up rooted allowing no loss of pods. The selected plants from each treatment were collected separately and thoroughly cleaned in water and separately dried at room temperature. After proper drying, the pods were separated. Mature and immature pods of each plot were again separated and their weights were taken separately. Data were collected on the following parameters:

a) Plant height (cm)
b) Number of primary branches/ plant
c) Number of pods/ plant
d) Number of mature pods/ plant
e) Weight of pods/plant (g)
f) Weight of kernals/ plant (g) and
g) Shelling percentage

The shelling percentage was calculated as follows:

$$\text{Shelling percentage} = \frac{\text{Weight of pods/plant} - \text{Weight of kernals/plant}}{\text{Weight of pods/plant}} \times 100$$

3.8.13. Data analysis

The collected data were statistically analyzed and LSD test were done to evaluate the level of significance of the treatments.

RESULTS

RESULTS

4.1. Laboratory experiment

4.1.1. Effect of seed treatment with Bion, Amistar and vitavax -200 on the prevalence of seed borne fungi of peanut var. Dhaka 1 (Blotter method)

Significant variation among the effect of different treatments in respect of percent seed borne fungi were observed (Table 1). Panut seeds yielded *Aspergillus niger* (Fig. 4), *A. flavus* (Fig. 5), *Sclerotium* rolfsii (Fig. 7), *Fusarium oxysporum* (Fig. 8), *Rhizoctonia solani* (Fig.6), *Macrophomina phaseolina* (Fig. 9) and *Penicillium* sp. (Fig 10). It was observed that none of the treatments could completely inhibit the growth of seed borne *Aspergillus niger* and *A. flavus*. Bion and Amistar showed significant effect in reducing seed borne *A. niger* and *A. flavus*, where Amistar (0.05%) showed best performance. The growth of *Sclerotium rolfsii*, *Fusarium* spp. and *Rhizoctonia solani* was completely controlled when seeds were treated with Bion (0.01%), Amistar (0.05% and 0.1%) and Vitavax-200 (0.3% of seed weight). The growth of *Macrophomina phaseolina* was completely inhibited when seeds were treated with Amistar (0.1%) and Vitavax-200 (0.3% of seed wieght). The highest prevalence of *Penicillium* spp. (2.33%) was observed in T_2 (Bion 0.005%), followed by T_1 (untreated control) treatment.

4.1.2. Effect of seed treatment with Bion, Amistar and Vitavax-200 on the prevalence of seed fungi of peanut var. Jhinga badam

Seed treatment with Bion, Amistar and Vitavax-200 showed significant influence on the prevalence of seed borne fungi of peanut var. Jhinga badam (Table 2). The highest (19.32%) prevalence of *Aspergillus niger* was recorded in T_1 (untreated control) and significant reduction was observed when the seeds were treated with

Table 1. Effect of seed treatment with Bion, Amistar and Vitavax-200 on the prevalence of seed borne fungi of Peanut var. Dhaka-1 (Blotter method)

Treatments	Prevalence of seed borne fungi (%)						
	Aspergillus niger	*Aspergillus flavus*	*Sclerotium rolfsii*	*Fusarium* spp.	*Rhizoctonia solani*	*Macrophomina phaseolina*	*Penicillium* spp.
T_1	19.00a	18.00a	2.33a	5.00a	2.00a	3.00a	1.67b
T_2	7.33b	11.00b	0.67b	2.67b	1.33b	0.67d	2.33a
T_3	3.33c	11.67b	0.00c	0.00c	0.00c	1.33c	0.67c
T_4	1.00e	0.00d	0.00c	0.00d	0.00c	2.00b	0.00d
T_5	2.33d	2.00c	0.00c	0.00d	0.00c	0.00e	0.00d
T_6	3.33c	2.00c	0.00c	0.00d	0.00c	0.00e	0.00d
LSD ($P \geq 0.01$)	0.9383	0.7972	0.08138	0.1522	0.08136	0.1819	0.1151

200 seeds were tested for each treatment

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

Fig. 4. Growth of *Aspergillus niger* on seeds of peanut

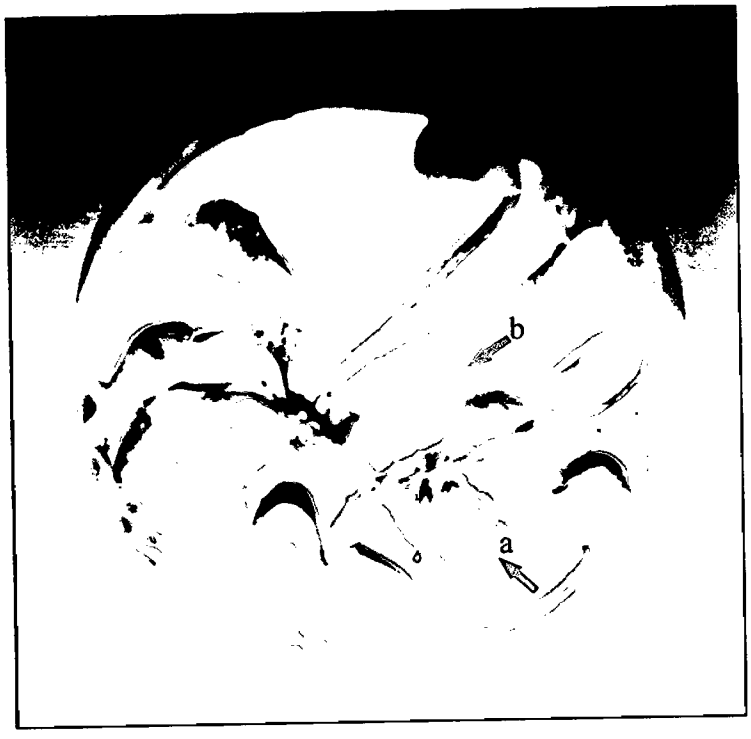


Fig. 5. Growth of fungi on seeds of peanut
a. *Aspergillus flavus*
b. *Rhizoctonia solani*

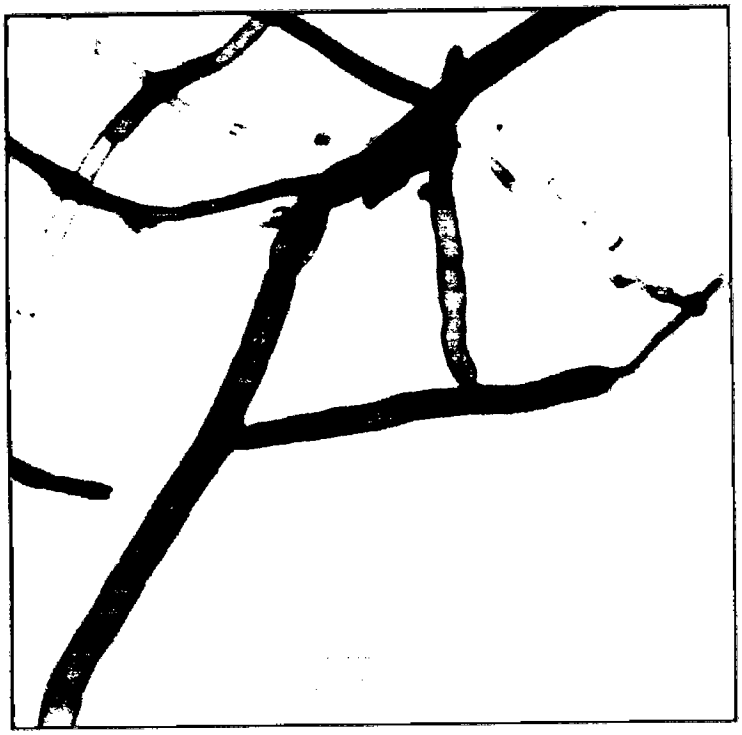


Fig. 6. Mycelia of *Rhizoctonia solani*

Fig. 7. Growth of *Sclerotium rolfsii* on seed of peanut

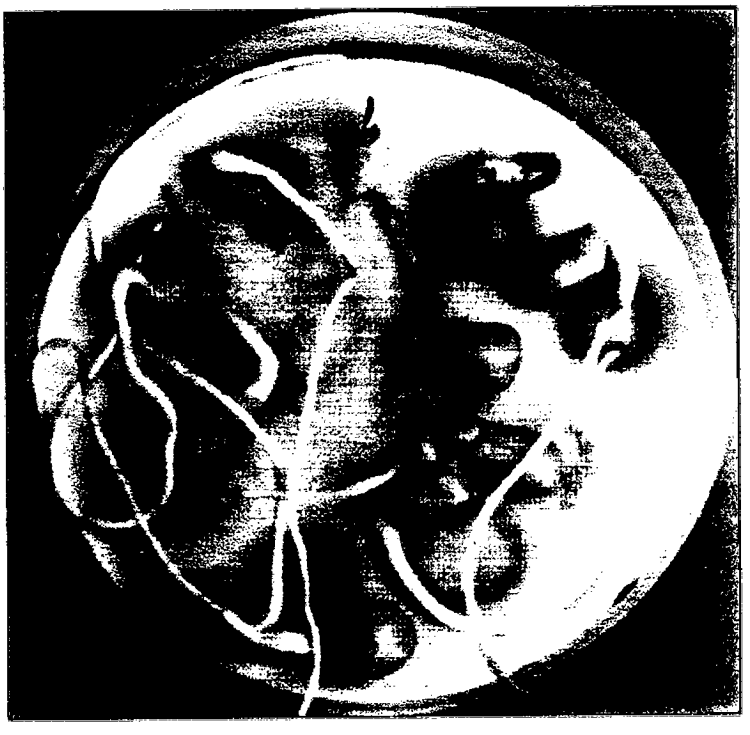


Fig. 8. Growth of *Fusarium oxysporum* on seed of peanut

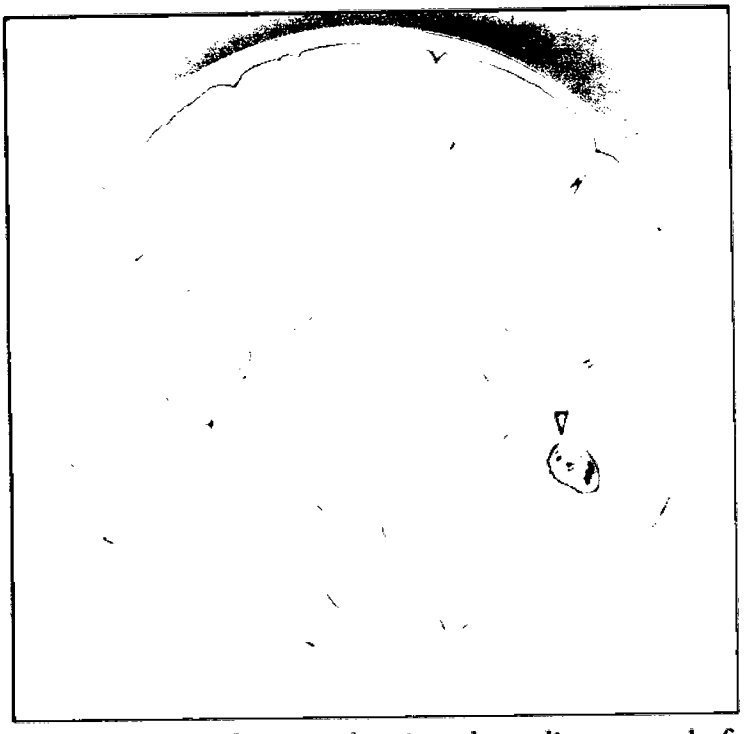


Fig. 9. Growth of *Macrophomina phaseolina* on seed of peanut

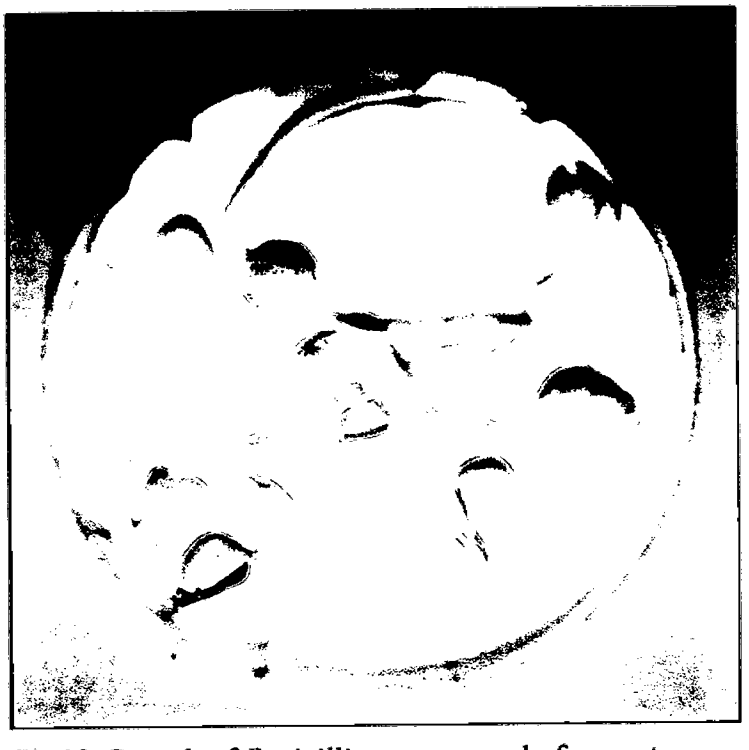


Fig.10. Growth of *Penicillium* sp.on seed of peanut

Table 2. Effect of seed treatment with Bion, Amistar and Vitavax-200 on the prevalence of seed borne fungi of Peanut var. Jhinga badam (Blotter method)

Treatments	Prevalence of seed borne fungi (%)						
	Aspergillus niger	*Aspergillus flavus*	*Sclerotium rolfsii*	*Fusarium* spp.	*Rhizoctonia solani*	*Macrophomina phaseolina*	*Penicillium* spp.
T_1	19.32a	12.33a	0.67a	2.67a	3.33a	3.33a	2.00a
T_2	16.33b	9.00b	0.00b	0.00b	0.67b	1.33b	1.67b
T_3	3.33c	6.00c	0.00b	0.00b	0.67b	1.00c	1.00c
T_4	4.00c	2.00d	0.00b	0.00b	0.00c	0.00d	0.00d
T_5	2.00d	1.33de	0.00b	0.00b	0.00c	0.00d	0.00d
T_6	1.33d	1.00e	0.00b	0.00b	0.00c	0.00d	0.00d
LSD ($P \geq 0.01$)	0.9005	0.7867	0.5753	0.08136	0.1151	0.1151	0.1151

200 seeds were tested for each treatment

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.1%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

Table 2. Bion, Amistar and Vitavax-200. The lowest (1.33%) prevalence of *A. niger* was recorded in T_6 (Vitavax-200 0.3% of seed weight). The similar trend of effect of chemicals was also recorded in case of *Aspergillus flavus*, where maximum prevalence (12.33%) of it was recorded in T_1 (untreated control) and lowest (1.0%) in T_6 (Vitavax-200 0.3% of seed weight). But *Sclerotium rolfsii* and *Fusarium spp.* were not observed in treated seeds. Though Bion showed significant reduction of seed borne *Rhizoctonia solani,* but Amistar and Vitavax-200 completely controlled seed borne *Rhizotionia solani.* The similar trend of effect of chemicals were also observed in case of *Macrophomina phaseolina* and *Penicillium spp.*

4.2. Germination test

4.2.1. Effect of seed treatment with Bion, Amistar and Vitavax-200 on germination of peanut var. Dhaka 1 in Blotter, water agar slants and PDA slants

The germination of peanuut var. Dhaka 1 did not differ significantly on blotter though the germination in all treatments ranged from 92.00-99.33% (Table 3). In case of water agar slants the germination of peanut var. Dhaka 1 significantly varied form 73.30 to 93.30%, where the lowest and the highest counts were made in T_3 (Bion 0.01%) and T_6 (Vitavax-200 0.3% of seed weight), respectively. In case of PDA slants the highest germination (87.0%) was observed in T_2 (Bion 0.005%) and T_6 (Vitavax-200 0.3% of seed weight) and lowest (27%) in T_1 (untreated control).

Table 3. Effect of seed treatment with Bion, Amistar and Vitavax-200 on germination of Peanut var. Dhaka-1 in Blotter, water agar slants and PDA slants

Treatment	Germination (%)		
	Blotter method	Water agar slants	PDA slants
T_1	92.66	90.00ab	27.00c
T_2	94.33	80.00bc	87.00a
T_3	92.00	73.30c	67.00b
T_4	96.33	90.00ab	80.00a
T_5	99.33	90.00ab	67.00b
T_6	97.33	93.30a	87.00a
LSD ($P \geq 0.01$)	NS	10.46	7.860

200 seeds were tested for each treatment

NS= Not significant

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

4.2.2. Effect of seed treatment with Bion. Amistar and Vitavax-200 on germination of peanut var. Jhinga badam in Blotter, water agar slants and PDA slants

Germination of seeds of peanut var. Jhinga badam was found to vary significantly under different treatments in case of blotter and PDA slants (Table 4). The germination in blotter and PDA slants under different treatments ranged from 90.00 to 99.00% and 13.33 to 80.00%, respectively. Though germination in water agar slants under different treatments varied from 93.3 to 100% but did not differ significantly. Comparatively Vitavax-200 showed best performance regarding germination of treated seeds.

4.3. Challenge test

4.3.1. Effect of seed treatment with Bion, Amistar and Vitavax-200 on germination, post emergence death and percent seedlings stand of peanut var. Dhaka 1 and Jhinga badam when seed inoculated with *Aspergillus niger* at sowing (PDA)

In case peanut var. Dhaka 1 the highest (100%) germination was observed in T_6 (Vitavax-200 0.3% of seed weight) and germination failure has been found in T_1 (untreated control) and T_3 (Bion 0.01%) as shown in Table. In case of Jhinga badam the highest (100%) germination was recorded in T_6 (Vitavax-200 0.3% of seed weight) and lowest (33%) in T_4 (Amistar 0.05%), where as germination failure recorded in T_1 (untreated control), T_2 (Bion 0.005%) and T_3 (Bion 0.01%). 100% post emergence death has been recorded in both the varieties under different treatments. The study clearly showed that none of treatments was found to be effective in controlling *Aspergillus niger* (Fig. 11).

Table 4. Effect of seed treatment with Bion, Amistar and Vitavax-200 on germination of Peanut var. Jhinga badam in Blotter, water agar slants and PDA slants

Treatment	Germination (%)		
	Blotter method	Water agar slants	PDA slants
T_1	90.00b	93.30	13.50e
T_2	95.33ab	96.70	13.33e
T_3	98.33a	96.70	20.00d
T_4	95.00ab	96.70	30.00c
T_5	99.00a	93.30	46.67b
T_6	97.00a	100.0	80.00a
LSD ($P \geq 0.01$)	5.598	NS	3.003

200 seeds were tested for each treatment

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

Table 5. Effect of seed treatment with Bion, Amstar and Vitavax-200 on germination and post emergence death and percent seedling stand of peanut when seed inoculated with *Aspergillus niger* at sowing (PDA medium)

Treatments	Germination (%)		Post emergence death(%)		Seedling stand (%)	
	Dhaka 1	Jhinga badam	Dhaka 1	Jhinga Badam	Dhaka 1	Jhinga badam
T_1	0	0	0	0	0	0
T_2	66	0	100	0	0	0
T_3	0	0	0	0	0	0
T_4	66	33	100	100	0	0
T_5	66	66	100	100	0	0
T_6	100	100	100	100	0	0

Data represents the mean of three replications and data were recorded 21 days after sowing

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

4.3.2. Effect of seed treatment with Bion, Amirtar and Vitavax-200 on germination, post emergence death and percent seedlings stand of peanut var. Dhaka 1 and Jhinga badam when seed inoculated with *Sclerotium rolfsii* at sowing (PDA medium)

In case of peanut var. Dhaka 1 and Jhinga badam the highest germination and post emergence death were observed in T_6 (Vitavax-200 0.3% of seed wt.) which is followed by T_5 (Table 6). Total germination failure was observed in control (Fig 12) and T_3 (Bion 0.01%). Out of the chemicals tested Vitavax-200 was found best for germination by controlling *Sclerotium rolfsii.*

4.3.3. Effect of seed treatment with Bion, Amistar and Vitavax-200 on germination, post emergence death and percent seedlings stand of peanut var. Dhaka 1 and Jhinga badam when seed inoculated with *Fusarium oxysporum* at sowing (PDA medium)

In case of peanut var. Dhaka-1 the highest (100%) germination was observed in T_2 (Bion 0.005%), T_5 (Amistar 0.1%) and T_6 (Vitavax-200 0.3% of seed weight) whereas, in case of var. Jhinga badam maximum (66%) germination was observed in T_3 (Bion 0.01%) T_4 (Amistar 0.05%) T_5 (Amistar 0.1%) and T_6 (Vitavax-200 0.3% of seed weight) as shown in Table 7. The challenge test showed that *Fusarium oxysporum* caused post emergence death of seedlings (Fig. 13). Germination failure has been found in T_1 (untreated control) and T_2 (Bion 0.005%). Maximum post emergence death (100%) in var. Dhaka 1 has been recorded in T_1 (untreated control), T_2 (Bion 0.005%)

Table 6. Effect of seed treatment with Bion, Amstar and Vitavax-200 on germination and post emergence death and percent seedling stand of peanut when seed inoculated with *Sclerotium rolfsii* at sowing (PDA medium)

Treatments	Germination (%)		Post emergence death(%)		Seedling stand (%)	
	Dhaka 1	Jhinga badam	Dhaka 1	Jhinga Badam	Dhaka 1	Jhinga badam
T_1	33	0	100	0	0	0
T_2	0	0	0	0	0	0
T_3	0	0	0	0	0	0
T_4	33	0	100	0	0	0
T_5	0	0	0	0	0	0
T_6	100	100	33	0	67	100

Data represents the mean of three replications and data were recorded 21 days after sowing

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

Table 7. Effect of seed treatment with Bion, Amstar and Vitavax-200 on germination and post emergence death and percent seedling stand of peanut when seed inoculated with *Fusarium oxysporum* at sowing (PDA medium)

Treatments	Germination (%)		Post emergence death(%)		Seedling stand (%)	
	Dhaka 1	Jhinga badam	Dhaka 1	Jhinga Badam	Dhaka 1	Jhinga badam
T_1	66	0	100	0	0	0
T_2	100	0	100	0	0	0
T_3	66	66	100	100	0	0
T_4	66	66	50	0	50	100
T_5	100	66	0	0	100	100
T_6	100	66	33	66	67	0

Data represents the mean of three replications and data were recorded 21 days after sowing

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

Fig. 13. Challenge test with *Fusarium oxysporum*
a) Post emergence death of seedling due to *Fusarium oxysporum* inoculation

and T_3 (Bion 0.01%). In case of peanut var. Jhinga badam 100% post emergence mortality was recorded in T_3 (Bion 0.01%) followed by 66% in T_6 (Vitavax-200 0.3% of seed weight). This study clearly showed that Amistar is best for controlling *Fusarium oxysporum* with the highest in germination.

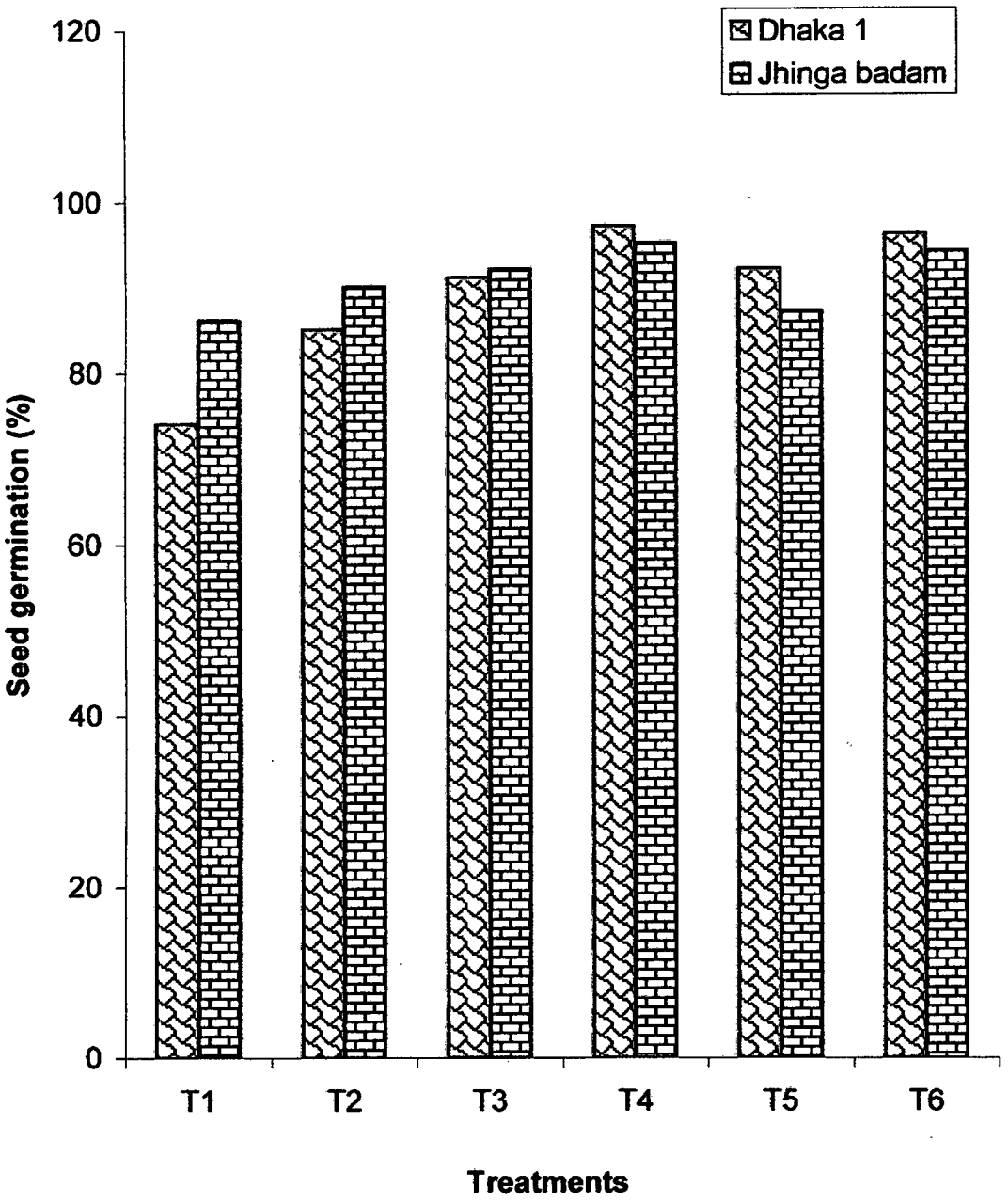
4.4. Field experiments

4.4.1. Effect of seed treatment with Bion, Amistar and Vitavax-200 on germination of peanut var. Dhaka-1 and Jhinga badam in the field

The germination of treated seeds of peanut var. Dhaka 1 and Jhinga badam under field condition ranged from 74 to 97% and 86 to 95%, respectively (Fig. 14). But it has been observed that the germination of both the peanut varieties under different treatment did not differ significantly.

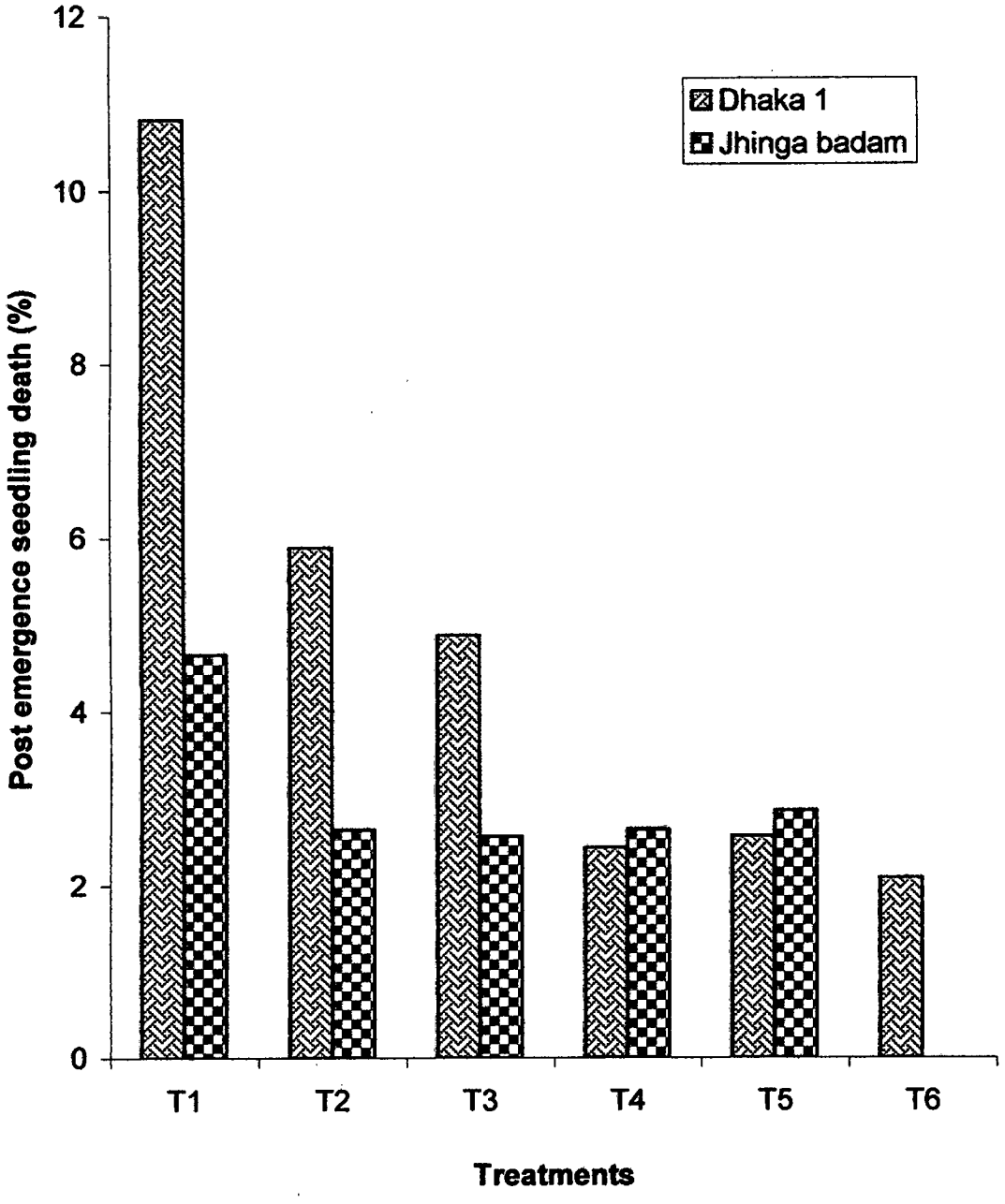
4.4.2 Effect of seed treatment with Bion, Amistar and Vitavax-200 on post emergence death of Peanut var. Dhaka 1 and Jhinga badam in the field

Post emergence death seedling of peanut var. Dhaka 1 and Jhinga badam varied from 2.08 to 10.81% and 2.56 to 4.65%, respectively (Fig. 15). The highest post emergence death of peanut var. Dhaka 1 and Jhinga badam was recorded in T_1 (untreated control) as shown in Fig. 16 and the lowest in T_6 (Vitavax-200 0.3% of seed weight).



T_1 = (Untreated control)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

Fig. 14. Effect of seed treatment with Bion, Amistar and Vitavax-200 on germination of Peanut var. Dhaka 1 and Jhinga badam in the field



T_1 = (Untreated control)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

Fig. 15. Effect of seed treatment with Bion, Amistar and Vitavax-200 on post emergence death of Peanut seedlings in the field

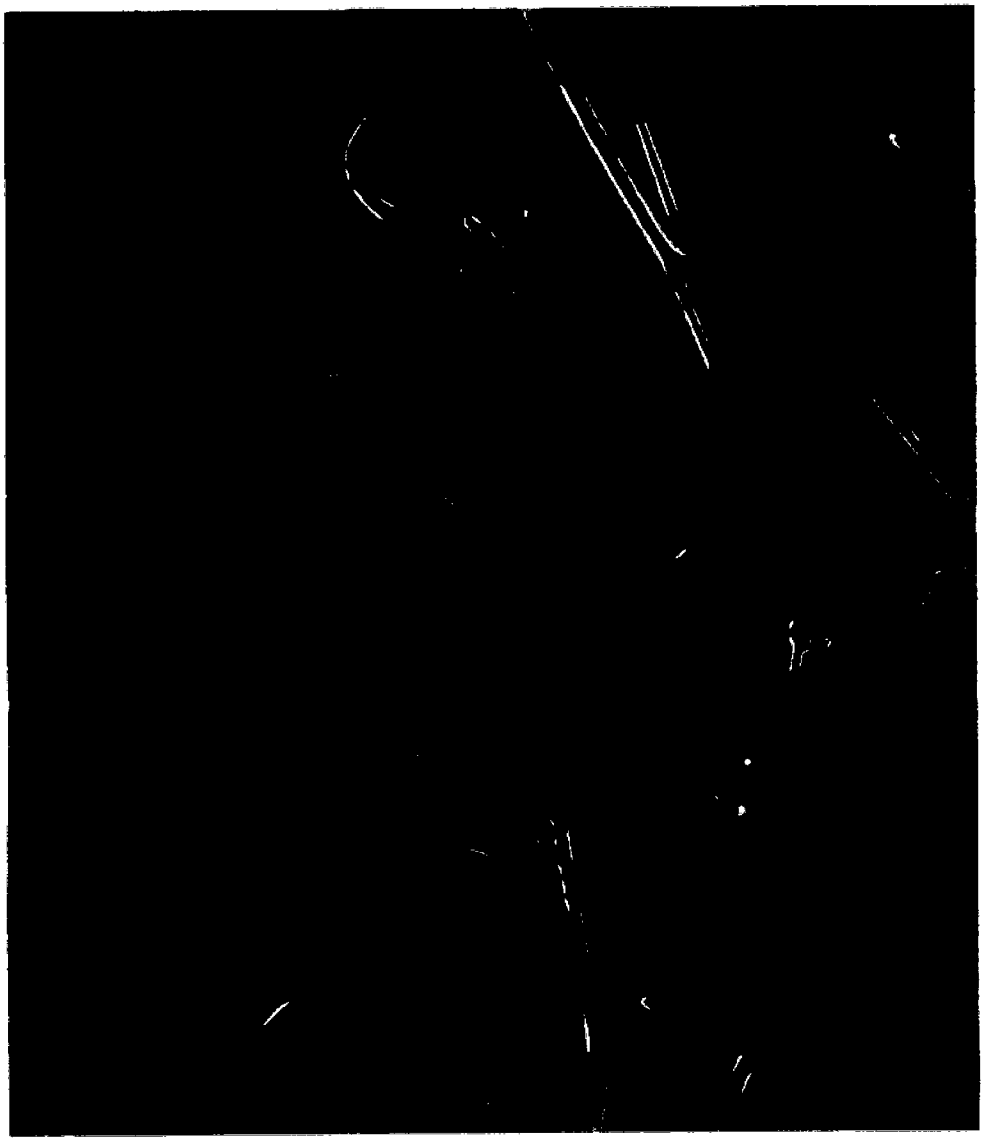


Fig. **16. Post emergence death of peanut seedling**

4.5. Assessment of severity of tikka disease

4.5.1. Effect of seed treatment with Bion, Amistar and Vitavax-200 on total number of leaflets /plant, total number of diseased leaflets/ plant and percent leaf infected (tikka disease) of Peanut var. Dhaka-1

The significant effect of different treatments on total number of leaflets/plant, total number of diseased leaflets/ plant and percent leaf infected was observed at different counting periods (Table 8.). At first counting (110 days after sowing) the highest number of leaflets/plant (368.1) was observed in T_6 (Vitavax-200 0.3% of seed weight) and the lowest (273.0) in T_4 (Amistar 0.05%). The number of diseased leaflets per plant was recorded highest (55.3) in T_1 (untreated control) and the lowest (26.1) in T_3 (Bion 0.01%). But percent leaf infection was highest (18.3%) in T_1 (untreated control) and the lowest (9%) in T_3 (Bion 0.01%) treatment.

In case of second counting (120 days after sowing) the highest number of leaflets /plant (351.60) was recorded in T_6 (Vitavax-200 0.3% of seed weight) and the lowest (229.4) in T_3 (Bion 0.01%). Total number of diseased leaflets /plant ranged from 33.70 to 80.00, where the highest and lowest counts were made in T_1 (untreated control) and T_3 (Bion 0.01%), respectively. The highest percent leaf infection (25.86%) was recorded in T_1 (untreated control) and the lowest (11.39%) in T_5 (Amistar 0.1 %).

Incase of 3rd counting (130 days after sowing) the highest number of leaflets/ plant (356.7) was found in T_6 (Vitavax-200 0.3% of seed weight) and the lowest (225.4) in T_3 (Bion 0.01%). Total number of diseased leaflets/plant varied from 88.7 to

Table 8. Effect of seed treatment with Bion, Amistar and Vitavax-200 on total number of leaflets/plant, total number of diseased leaflets/plant and percent leaf infected (tikka disease) of Peanut var. Dhaka-1

Treatments	1st counting (110 days after sowing)			2nd counting (120 days after sowing)			3rd counting (130 days after sowing)		
	Total no. of leaf-lets/plant	Total no. of diseased leaflets/ plant	Percent leaf infected	Total no. of leaflets/ plant	Total no. of diseased leaflets/ plant	Percent leaf infected	Total no. of leaflets/ plant	Total no. of diseased leaflets/ plant	Percent leaf infected
T_1	302.10d	55.30a	18.31a	309.30dc	80.00a	25.86a	301.10c	113.10b	37.56a
T_2	325.00c	31.40c	9.66d	333.60b	43.10d	12.91d	338.70b	99.20c	29.28d
T_3	250.40b	26.10e	9.00e	229.40d	33.70e	14.69c	255.40d	88.70d	34.72b
T_4	273.00e	29.90cd	10.94c	305.80dc	56.10c	18.34b	292.80c	100.40c	34.28b
T_5	296.20d	28.10de	9.48de	297.60c	33.90e	11.39e	282.80c	93.30cd	32.99c
T_6	368.10a	43.50b	16.22b	351.60a	64.70b	18.40b	356.70a	131.00a	36.79a
LSD ($P \geq 0.01$)	14.10	2.702	0.5865	16.49	2.781	0.6800	17.52	6.811	1.091

Data represents the mean of 10 replications

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

131.0%, where the highest and the lowest results were recorded in T_6 (Vitavax-200 0.3% of seed weight) and T_3 (Bion 0.01%), respectively. The highest percent leaf infection (37.56%) was observed in T_1 (untreated control treatment) which is statistically similar to T_6 (Vitavax-200 0.3% of seed weight). The lowest percent leaf infection (29.28%) was recorded when seeds were treated with T_2 Bion (0.05%).

4.5.2. Effect of seed treatment with Bion, Amistar and Vitavax-200 on total number of leaflets /plant, total number of diseased leaflets/ plant and percent leaf infected (tikka disease) of Peanut var. Jhinga badam

The significant effect of different treatments in respect of the number of leaflets /plant, total number of diseased leaflets /plant and percent leaf infected was observed at different counting periods (Table 9). In case of first counting (110 days after sowing) the highest number of leaflets /plant (407) was recorded in T_5 (Amistar 0.1%) and the lowest (292.5) in T_2 (Bion 0.005%). The highest number of diseased leaflets /plant (12.10) was observed in T_3 (Bion 0.01%) and lowest (5.02) in T_5 (Amistar 0.1%). The percent leaf infection was varied from 1.33 to 3.73% where the highest and lowest counts were made in T_3 (Bion 0.01%) in T_5 (Amistar 0.1%), respectively.

Incase of second counting the highest number of leaflets /plant (409.0) was observed in T_5 (Amistar 0.1%) and the lowest (301) number of leaflets/plant was observed in T_2 (Bion 0.005%) and T_6 (Vitavax-200 0.3% of seed weight). The highest number of diseased leaflets /plant (65.1) was observed in T_1 (untreated control) and the lowest (30.00) in T_4 (Amistar 0.05%) and T_5 (Amistar 0.1%).

Table 9. Effect of seed treatment with Bion, Amistar and Vitavax-200 on total number of leaflets/plant, total number of diseased leaflets/plant and percent leaf infected (tikka disease) of Peanut var. Jhinga badam

Treatments	1st counting (110 days after sowing)			2nd counting (120 days after sowing)			3rd counting (130 days after sowing)		
	Total no. of leaf-lets/plant	Total no. of diseased leaflets/ plant	Percent leaf infected	Total no. of leaflets/ plant	Total no. of diseased leaflets/ plant	Percent leaf infected	Total no. of leaflets/ plant	Total no. of diseased leaflets/ plant	Percent leaf infected
T_1	355.00b	11.05b	3.110b	361.50b	65.10a	18.00b	365.50b	113.40b	31.02c
T_2	292.50d	9.20c	3.140b	301.00d	45.20c	15.01c	305.00de	103.60c	39.66a
T_3	324.00c	12.10a	3.730a	329.50c	60.90b	18.48b	334.50c	125.60a	37.54b
T_4	313.00c	6.02d	1.920c	317.00cd	30.00d	9.360d	319.60cd	62.90e	19.68d
T_5	407.00a	5.02e	1.330d	409.00a	30.00d	7.330e	413.10a	125.50a	30.38c
T_6	295.00d	9.20a	3.110b	301.00d	60.02b	19.94a	302.10e	88.70d	29.56c
LSD ($P \geq 0.01$)	12.53	0.6049	0.1066	16.78	2.705	0.7075	16.54	5.128	1.662

Data represents the mean of 10 replications

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

Percent leaf infection was found highest (19.94%) in T_6 (Vitavax-200 0.3% of seed weight) and the lowest in (7.33%) in T_5 (Amistar 0.1%).

Incase of 3rd counting (130 days after sowing) total number of leaflets/ plant varied from 302.1 to 413.10 where the highest and the lowest count was made in T_5 (Amistar 0.1%) and T_6 (Vitavax-200 0.3% of seed weight), respectively. The maximum number of diseased leaflets/plant (125.6) was recorded in T_3 (Bion 0.01%) which was statistically identical with T_5 (Amistar 0.1%) and minimum number of diseased leaflets/plant (88.0) was observed in T_6 (Vitavax-200 0.3% of seed weight). The percent leaf infection varied form 19.68 to 39.66% where the highest and lowest count was recorded in T_2 (Bion 0.005%) and T_4 (Amistar 0.05%), respectively.

4.5.3. Effect of seed treatment with Bion, Amistar and Vitavax-200 on percent leaf area diseased (tikka disease) in peanut var. Dhaka 1

The effect of seed treatment with Bion, Amistar and Vitavax-200 on percent leaf area diseased (tikka disease) in peanut var. Dhaka 1 was determined and the results are presented in Table 10. In case of 1st counting percent leaf area diseased under different treatments varied significantly in case of upper leaf, middle leaf, and lower leaf of the plants. In case of upper leaves trace amount of spots were recorded only in T_1 (untreated control), T_2 (Bion 0.005%) and T_3 (Bion 0.01%), while T_4 (Amistar 0.05%), T_5 (Amistar 0.1%) and T_6 (Vitavax-200 0.3% of seed weight) were free from disease. But percent middle leaf area diseased varied from 5.53 to 9.35%, where the highest and lowest count was made in T_1 (untreated control) and T_3 (Bion 0.01%), respectively. Percent lower leaf area diseased ranged

Table 10. Effect of seed treatment with Bion, Amistar and Vitavax–200 on percent leaf area diseased with tikka in Peanut var. Dhaka 1

Treatments	1st counting (110 days after sowing)			2nd counting (120 days after sowing)			3rd counting (130 days after sowing)		
	% leaf area diseased			% leaf area diseased			% leaf area diseased		
	Upper leaf	Middle leaf	Lower leaf	Upper leaf	Middle leaf	Lower leaf	Upper leaf	Middle leaf	Lower leaf
T_1	1.13a	9.35a	19.95a	3.15a	12.95a	40.00a	14.22a	40.12a	69.00a
T_2	0.13c	6.28b	14.95b	0.80b	11.75b	26.25b	10.02c	30.75c	55.25c
T_3	0.18b	5.78cd	12.55d	0.50d	9.23d	23.00d	11.40b	30.62c	53.50c
T_4	0.00d	5.73c	13.65c	0.63c	11.30bc	23.97cd	11.80b	28.00d	48.12d
T_5	0.00d	5.63cd	15.42b	0.18f	11.42bc	25.60bc	10.40c	28.20d	43.07e
T_6	0.00d	5.53d	14.10c	0.33e	10.82c	27.125b	12.15b	33.87b	59.12b
LSD ($P \geq 0.01$)	0.208	0.406	0.779	0.040	0.731	1.830	0.901	2.212	1.915

Data represents the mean of 10 replications

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

from 12.55 to 19.95%, where the maximum and minimum result was recorded in T_1 (untreated control) and T_3 (Bion 0.1%), respectively.

In case of 2nd counting (120 days after sowing) the highest upper leaf upper leaf area diseased (3.15%) was observed in T_1 (untreated control) and the lowest (0.18%) in T_5 (Amistar 0.01%). Percent middle leaf area diseased ranged from 9.23 to 12.95% where the maximum and minimum count was recorded in T_1 (untreated control) and T_3 (Bion 0.01%), respectively. In case of lower leaf area diseased the highest count was recorded in T_1 (untreated control) and the lowest (12.95%) in T_3 (Bion 0.01%).

In case of 3rd counting (130 days after sowing) percent leaf area diseased varied significantly under different treatments regarding upper, middle and lower leaf. Percent upper leaf area diseased ranged from 10.02 to 14.22%, where the maximum and minimum count was made in T_1 (untreated control) and T_2 (Bion 0.005%), respectively. The percent middle leaf area diseased was observed highest (40.12%) in T_1 (untreated control) and the lowest (28.0%) in T_4 (Amistar 0.05%). Percent lower leaf area diseased varied from 43.07 to 69.0%, which were recorded in T_1 (untreated control) and T_5 (Amistar 0.1%), respectively.

4.5.4. Effect of seed treatment with Bion, Amistar and Vitavax-200 on percent leaf area diseased (tikka disease) in peanut var. Jhinga badam

The effect of seed treatment with Bion, Amistar and Vitavax-200 on percent leaf area diseased (tikka disease) in peanut var. Dhaka 1 was determined and the results are presented in Table 11. In case of 1st counting (110 days after sowing) percent leaf area diseased under different treatments varied significantly in case of upper

Table 11. Effect of seed treatment with Bion, Amistar and Vitavax–200 on percent leaf area diseased with tikka in Peanut var. Jhinga badam

Treatments	1st counting (110 days after sowing)			2nd counting (120 days after sowing)			3rd counting (130 days after sowing)		
	% leaf area diseased			% leaf area diseased			% leaf area diseased		
	Upper leaf	Middle leaf	Lower leaf	Upper leaf	Middle leaf	Lower leaf	Upper leaf	Middle leaf	Lower leaf
T_1	0.40c	5.82a	6.95a	2.02a	9.27a	16.95b	4.45b	18.27a	32.95a
T_2	0.30d	1.50b	2.50d	1.50bc	8.70b	14.50c	3.05e	16.70b	29.50b
T_3	0.45b	1.30c	4.07b	1.40a	8.87ab	20.07a	4.825a	16.87b	28.07bc
T_4	0.30d	1.20c	2.22e	1.50bc	7.60c	12.22d	3.05e	14.60d	26.22d
T_5	0.70a	1.00d	1.55f	1.40c	7.42c	14.55c	3.70c	15.85c	26.55cd
T_6	0.73a	1.45b	3.50c	1.582b	7.85c	12.50d	3.30d	14.12d	24.25e
LSD ($P \geq 0.01$)	0.040	0.117	0.131	0.103	0.465	0.864	0.176	0.817	1.749

Data represents the mean of 10 replications

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

leaf, middle leaf and lower leaf of the plants. In case of upper leaf trace amount of spots were recorded in all treatments. Percent upper leaf area diseased ranged from 0.30 to 0.73%, where the highest and the lowest count was made in T_6 (Vitavax-200 0.3% of seed weight) and T_4 (Amistar 0.05%), respectively. Percent middle leaf area diseased varied from 1.0 to 5.80%, where the highest and the lowest count was recorded in T_1 (untreated control) and T_5 (Amistar 0.1%), respectively. And percent lower leaf area diseased varied from 1.55 to 6.95%, which were recorded in T_5 (Amistar 0.1%) and T_1 (untreated control), respectively.

In case of 2nd counting (120 days after sowing) the highest upper leaf upper leaf area diseased (2.02%) was observed in T_1 (untreated control) and the lowest (1.5%) in T_2 (Bion 0.005%) and T_4 (Amistar 0.05%). Percent middle leaf area diseased ranged from 7.42 to 9.27% where the maximum and minimum count was recorded in T_1 (untreated control) and T_5 (Amistar 0.1%), respectively. In case of middle leaf area diseased the highest count (20.07%) was recorded in T_3 (Bion 0.01%) and the lowest (12.22%) in T_4 (Amistar 0.05%).

In case of 3rd counting (130 days after sowing) percent leaf area diseased varied significantly under different treatments regarding upper, middle and lower leaf. Percent upper leaf area diseased ranged from 3.05 to 4.82% where the maximum and minimum count was made in T3 (Bion 0.01%) and T_2 (Bion 0.005%), respectively. The percent middle leaf area diseased (18.27%) was observed in T_1 (untreated control) and the lowest (14.12%) in T_6 (Vitavax-200 0.3% of seed weight). Percent lower leaf area diseased varied from 24.25 to 32.95% which were recorded inT_6 (Vitavax-200 0.3 of seed weight) and T_1 (untreated control), respectively.

4.5.5. Effect of seed treatment with Bion, Amistar and Vitavax-200 on plant height and number of primary branches/plant in peanut var. Dhaka 1 and Jhinga badam

Plant height

The effect of different treatments on height of peanut var. Dhaka 1 and Jhinga badam was found significant (Table 12). The highest plant height (78.0 cm) of Dhaka 1 was recorded in T_2 (Bion 0.005%) and the lowest (64.80 cm) in T_4 (Amistar 0.05%). There was no statistical difference regarding plant height was found among T_1 (control), T_3 (Bion 0.01%), T_5 (Amistar 0.1%) and T_6 (Vitavax-200 0.3% of seed weight). The plant height of Jhinga badam ranged from 83.92 to 107.2 cm, where the highest and lowest heights were recorded inT_4 (Amistar 0.05%) and T_1 (untreated control), respectively.

Number of primary branches/plant

The treatments effect were significant on number of primary branches/plant of peanut var. Dhaka 1 and Jhinga badam (Table 12). The maximum branches/plant (7.7) of Dhaka 1 was recorded in T_2 (Bion 0.005%) and minimum (6.7) in T_1 (control untreated). In case of Jhinga badam the highest number (6.3) of primary branches/plant was recorded in T_1 (untreated control) and T_5 (Amistar 0.1%), where as lowest (5.7) count was made in T_6 (Vitavax-200 0.3% of seed weight).

Table 12. Effect of seed treatment with Bion, Amistar and Vitavax –200 on plant height and number of primary branches/plant of Peanut var. Dhaka 1 and Jhinga badam

Treatments	Plant height (cm)		Number of primary branches /plant	
	Dhaka 1	Jhinga badam	Dhaka 1	Jhinga badam
T_1	74.0b	83.9d	6.7c	6.3a
T_2	78.0a	97.7b	7.7a	6.0bc
T_3	73.0b	101.2b	7.4ab	6.2ab
T_4	64.8c	107.2a	7.0bc	5.9cd
T_5	74.9ab	105.0a	7.3ab	6.3a
T_6	73.4b	92.7c	7.3ab	5.7d
LSD (P≥0.01)	3.14	4.012	0.507	0.253

Data represents the mean of 10 replications

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

4.5.6. Effect of seed treatment with Bion Amistar and Vitavax-200 on yield and yield contributing characters of peanut var. Dhaka-1

Number of pods/plant

Significant effect of different treatments on total number of pods/plant was observed (Table 13). The highest number of pods/plant (34.80) was obtained in T_5 (Amistar 0.1%) and lowest (28.20) in T_2 (Bion 0.005%). Effect of T_1 (untreated control) and T_2 (Bion 0.005%) and T_3 (Bion 0.1%), T_4(Amistar 0.05%) and T_6 (Vitavax-200 0.3% of seed weight) were found statistically identical.

Total number of mature pods/plant

Total number of mature pods/plant varied from 24.8 to 33.5, where the maximum and minimum counts were recorded in T_5 (Amistar 0.1%) and T_2 (Bion 0.005%), respectively.

Weight of pods/plant

The effect of different treatments was found significant on the weight of pods/plant (Table 13). Weight of pod/plant ranged from 15.37 to 22.15 g, where the lowest weight of pods/plant was recorded in T_1 (control) and highest in T_4 (Amistar 0.05%), which is 44.11 % higher over control (T_1).

Weight of kernal /plant

Significant variation was found in different treatments in relation to weight of kernal /plant in peanut var. Dhaka 1 (Table 13). The highest weight of kernal/plant (17.36 g) was obtained in T_5 (Amistar 0.1%), which is 58.10 % higher over control (T_1), where lowest weight of kernal/plant (10.98 g) was

Table 13. Effect of seed treatment with Bion, Amistar and Vitavax–200 on yield and yield contributing characters of Peanut var. Dhaka 1

Treatment	Total number of pods/plant	Total number of mature pods/plant	Weight of pods/ plant (g)	Weight of kernal/ plant (g)	Shelling percentage
T_1	29.10c	31.60 b	15.37c	10.98d	28.56a
T_2	28.20c	24.80d	18.79b (22.25)	13.97c (27.23)	25.65b
T_3	30.90b	27.90c	19.53b (27.06)	14.53c (32.33)	25.60b
T_4	32.50b	30.30b	22.15a (44.11)	16.40b (49.36)	25.95b
T_5	34.80a	33.50a	22.02a (43.26)	17.36a (58.10)	21.16c
T_6	32.50b	30.30b	19.32b (25.69)	13.84c (26.04)	28.36a
LSD=(P≥0.01)	1.711	1.423	1.019	0.7675	1.397

Data represents the mean of 10 replications
Data in the parentheses indicate percent increase over control (untreated)

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

observed in T_1 (control). The effect of T_2 (Bion 0.005%), T_3 (Bion 0.01%) and T_6 (Vitavax 0.3% of seed wt.) were statistically similar.

Shelling percentage

Effect of different treatments on shelling percentage were evaluated and presented in Table 13. The maximum shelling percentage (28.56%) recorded in T_1 (control) which is statistically identical with T_6 (Vitavax-200 0.3% of seed wt.) and minimum (21.16%) was observed in T_5 (Amistar 0.1%). Effect of T_2 (Bion 0.005%), T_3 (Bion 0.01%) and T_4 (Amistar 0.05%) were found statistically similar.

4.5.7. Effect of seed treatment with Bion, Amistar and Vitavax-200 on yield and yield contributing characters of Peanut var. Jhinga badam

Number of Pods/plant

Significant effect of different treatments on total number of pods/plant was observed (Table 14). The highest number of pods/plant (14.8) was obtained in T_5 (Amistar 0.1%) and lowest (11.0) in T_3 (Bion 0.01%).

Number of mature pods/plant

The number of mature pods/plant varied from 9.50 to 13.10, where the highest and lowest counts were recorded in T_5 (Amistar 0.01%) and T_1 (untreated control), respectively. The effect of T_1 (untreated control) regarding number of mature pod yield/plant was statistically identical with T_2 (Bion 0.005%) and T_3 (Bion 0.01%).

Table 14. Effect of seed treatment with Bion, Amistar and Vitavax–200 on yield and yield contributing characters of Peanut var. Jhinga badam

Treatment	Total number of pods/plant	Total number of mature pods/plant	Weight of pods/ plant (g)	Weight of kernal/ plant (g)	Shelling percentage
T_1	11.10c	9.500c	10.74d	7.20e	32.96b
T_2	11.30c	9.700c	13.29c (23.74)	8.66c (16.85)	34.83a
T_3	11.00c	9.900c	10.85d .(1.02)	7.98d (10.83)	26.45d
T_4	13.70b	12.30b	18.17a (69.18)	13.71a (90.41)	25.54d
T_5	14.80a	13.10a	17.32a (61.26)	13.27a (84.30)	31.31c
T_6	13.30b	12.10b	14.98b (39.47)	10.97b (52.36)	26.76d
LSD=(P≥0.01)	0.7832	0.6439	0.8871	0.4876	1.359

Data represents the mean of 10 replications
Data in the parentheses indicate percent increase over control (untreated)

T_1 = Control (untreated)
T_2 = Bion (0.005%)
T_3 = Bion (0.01%)
T_4 = Amistar (0.05%)
T_5 = Amistar (0.1%)
T_6 = Vitavax-200 (0.3% of seed weight)

Weight of Pods/plant

The weight of pods/plant of peanut var. Jhinga badam was presented in Table 14. The weight of pods/plant varied from 10.74 to 18.17 g where the highest count was observed in T_4 (Amistar 0.05%), which is 69.18% higher over control (T_1) and lowest counts were recorded in T_1 (untreated control).

Weight of kernal/plant

The effect of different treatments on kernal weight/plant was observed significant (Table 14). The maximum weight of kernal/plant (13.71 g) was obtained in T_4 (Amistar 0.05%), which is 90.41 % higher over control (T_1). And the minimum weight of kernal/plant (7.2 g) was obtained from T_1 (control) followed by T_3 (Bion 0.01%).

Shelling percentage

Effect of different treatment on shelling percentage in peanut var. Jhinga badam were evaluated and presented in Table 14. The highest shelling percentage (34.83%) was recorded in T_2 (Bion 0.005%) and the lowest (25.54%) in T_4 (Amistar 0.05%). Effect of T_3 (Bion 0.01%), T_4 (Amistar 0.05%) and T_6 (Vitavax-200 0.3% of seed wt.) were found statistically similar.

DISCUSSION

DISCUSSION

The investigations were carried out to find out the efficacy of Bion (Benzothiadiazole) as a inducer, Amistar (azoxystrobin) and Vitavax-200 (carboxin) as fungicides to control some diseases of peanut viz. crown rot (*Aspergillus niger*), seed rot (*A. flavus*), foot and root rot (*Sclerotium rolfsii*), wilt (*Fusarium spp.*) and tikka (*Cercespora arachidicola* and *Cercosporidium personatum*) of peanut. Bion at 0.005% and 0.01% solution, Amistar at 0.05% and 0.1% solution and Vitavax-200 at 0.3% of seed weight were used for treating the seeds of peanut. In case of Bion and Amistar, seeds were dipped in solution for 6 hours before sowing.

The blotter test showed that six different fungi viz. *Aspergillus (A. niger, A. flavus), Sclerotium rolfsii, Fusarium* spp. *(F. oxysporum, F. moniliforme), Rhizoctonia solani, Macrophomina phaseolina* and *Penicillium spp.* were associated with the seeds of peanut var. Dhaka 1 and Jhinga badam. A considerable number of seed borne fungi belonging to the genera *Aspergillus, Sclerotium, Fusarium, Macrophomina, Rhizoctonia* and *Penicillium* have also been detected in peanut seeds by a number of researchers (Subrahmanyam, 1991; Reddy, *et al.* 1991, Lisker *et al.* 1994 and Javed *et al.* 1998). Bion and Amistar showed significant effect in reducing seed borne *A. niger* and *A. flavus.* Rideout *et al.* (2002) reported that in furrow applications of azoxystrobin (Amistar) did suppress levels of *Aspergillus* crown rot (*Aspergillus niger*). Amistar and Vitavax-200 completely inhibited growth of *Selerotium rolfsii, Fusarium spp., Rhizoctonia solani* and *Penicillium spp.*, in both the varieties of peanut. Jorgensen (2000) used 0.5 l/ha of Amistar alone or Amistar + Folicur and reported that Amistar alone or in combination with

Folicur could provide a broad and good control against *Fusarium* ear blight. Rideout *et al.* (2002) obtained good result by applying Amistar in peanut field. They reported that Amistar did suppress level of Southern stem rot of peanut (*Sclerotium rolfsii*). Seed treatment with Vitavax reduced root rot (*Sclerotium rolfsii*) of groundnut has also been supported by Yahia *et al.*1979; Shekhawat *et al.* 1986 and Dalvi and Raut, 1987. In the present study Bion also showed excellent effect against seed borne *Aspergillus, Sclerotium, Fusarium, Rhizoctonia, Macrophomina* and *Penicillium* . In support of this study no reference on Bion in world literature has been found as it is a new chemical inducer in the discipline of Plant Pathology.

Germination of peanut seeds was highest in blotter and water agar slants whereas it was lowest in PDA slants. The germination was lower in PDA slants because PDA is a rich medium for the growth of fungi that hampers the germination of seeds. Luxuriant growth of different seed borne fungi on PDA has been detected whereas on water agar and blotter the growth of fungi was feeble. Comparatively Vitivax-200 showed better performance regarding germination of treated seeds. Bion (0.005%) showed good results though minimum germination was recorded in T_3 (Bion 0.01%). Bion is not a fungicide. It is the first compound of new generation of crop protection agents, an inducer of resistance that showed SAR in plants (Schlossor, 1997; Janczak and Bielecki, 1997 and Ruess *et al.* 1997). The present study also showed that peanut germination in blotter was not affected by *Aspergillus niger, A. flavus, Rhizoctonia solani, Macrophomina phaseolina* and *Fusarium spp.* Reddy *et al.* (1991) observed that seed germination was not significantly different due to seed treatment as seeds under control affected by *A. niger, A. flavus, A. terreus, Rhizoctonia bataticola* (*Macrophomina phaseolina*) or *Fusarium* as all pathogens commonly occurring on groundnut seeds.

In case of challenge test with *Aspergillus niger*, maximum germination failure was observed when seeds were treated with Bion that might be due to that Bion has no fungicidal effect. Amistar and Vitavax-200 showed best performance regarding germination though 100% post emergence death was observed. The study showed that none of the treatments was found to be effective in controlling *A. niger*. Bansal and Sobti (1988) dressed groundnut seeds with 6 fungicides (Bavistan, Blitox-50, Brassicol, Dithane M-45, Thiram and Vitavax-200 [carboxin]) and observed that seed germination improved with all treatments except carboxin. This is accordance with the findings of the present study.

Vitavax-200 has been found to be more effective in increasing germination and decreasing post emergence death in challenge test with *Sclerotium rolfsii*. This finding is supported by Peshney and Moghe, 1980; Dalvi and Raut, 1987 and Rideout *et al.* 2002. Amistar is the best to increase germination and decrease post emergence death in challenge test with *Fusarium oxysporum*. This results is an agreement with the observation made by Jorsensen (2000).

Bion, Amistar and Vitavax-200 increased germination and decreased post emergence death caused by seed borne and soil borne fungi under field condition. Schlosser (1997) reported that application of Bion to seed boxes of rice protect the plants after transplantation in to the field completely for about 70 days against *Magnaponthe grisea*, the causal agent of rice blast. Hessenauer and Glaser (2000) evaluated the effectiveness of different fungicides against rust (*Melampsora hypericorum* and *Uredo hyperici*) resistance and reported that preventive treatments with Amistar kept plants disease free. Amistar 250 SC is the most effective

fungicides to control plant pathogens which provided levels of disease control equivalent to or better than current commercial standards.

The effectiveness of Bion, Amistar and Vitavax-200 for controlling tikka disease of peanut in the field has been evaluated under natural epiphytic condition. Bion (0.01%) is more effective in peanut var. Dhaka 1 at first counting (110 days after sowing) to reduce the incidence of leaf infection by Cercospora leaf spot compared to the untreated control plants. Bion is more effective in peanut var. Dhaka 1 to reduce number of diseased leaflets/plant compared to control, Amistar and Vitavax-200. Zeller *et al.* (1999) stated that the plant activator Bion (Acibenzolar-S-methyl) has a systemic acquired resistance (SAR) effect against several phytopathogens. Amistar and Vitavax-200 were also effective but their effect was not better than Bion. At third counting (130 days after sowing) Bion (0.005%) showed remarkable effect compared to the other treatments. Janczak and Bielecki (1997) reported that Bion 50 WG provided reliable and commercially accepted protection in several crops against a number of diseases. Amistar is more effective in peanut var. Jhinga badam to reduce number of diseased leaflets/plant at all counting periods compared to the control, Bion and Vitavax-200. Amistar has a good effect in reducing incidence of leaf infection compared to the other treatments. Amistar was effective against all important cereal pathogens and a new standard for control of net blotch in barley (*Pyrenophora teres*), tan spot (*P. tritici repentis*) and glume blotch (*Leptosphaeria nodorum*) in wheat and brown rust in rye (Komradt *et al.* 1996). Comparatively Bion is effective in peanut var. Dhaka 1 to reduce percent upper and middle leaf area diseased at 1st and 2nd counting periods. Amistar is also effective to reduce percent upper, middle and lower leaf area diseased at 3rd counting periods. Amistar is more effective in peanut var. Jhigna badam to reduce percent leaf area diseased regarding upper middle and lower leaves at all counting periods.

Bion and Vitavax-200 also effective chemicals but effect was not better than Amistar.

Bion (0.005%) and Amistar (0.05%) were found more effective in increasing plant height in peanut var. Dhaka 1 and Jhinga badam. Bion and Amistar has a good effect in increasing number of primary branches/plant.

The findings of the present study showed that Amistar has a significant effect on the yield and yield contributing characters of peanut compared to other treatments. Amistar is more effective to increase total number of pods/plant, total number of mature pods/plant, weight of pods/plant and weight of kernal/plant. Both the varieties gave alike results. Use of Amistar resulted upto 69.18% and 84.30% pod weight/plant and kernal weight/plant over control. Jensen (1997) observed good control of a wide range of pathogens resulted in increase yields with improved grain quality in terms of 1000-grain weight and size of cereals of in Denmark. Amistar was found to show positive influence on yield, thousand grain weight of cereals as reported by Jensen (1999). Amistar gave the highest grain yield of rice cultivars BR11 and BRRI Dhan32 (Firoz, 2001). Hossain (2002) observed that Amistar treated plants gave the highest yield of rice cultivar BR11 when Amistar sprayed at tillering stage. Application of Bion has been found to increase pod yield/plant upto 27.06% over control, whereas it increased kernal yield/plant by upto 32.33% over control (untreated). Firoz and Hossain (2000) sprayed Bion before a week of ear initiation of rice for controlling some major diseases of rice cv. BR11 and BRRI Dhan32 and obtained yield increase by 40.46% and 9.55%, respectively. Higher grain yield of rice has been recorded by applying Bion as foliar spray of rice (Hossain 2002). The findings of the present study clearly showed that use of Vitavax-200 as seed treating chemicals increased pod

yield/plant and kernal yield/plant by 39.47% and 52.36%, respectively over control. These findings are supported by Nofal *et al* (1990) and Awad *et al.* (1994). According to them peanut seed treated with vitavax (Carboxin) resulted an increase in yield and seed weight as well as good control of diseases.

The findings of the present study has clearly pointed out that among the chemicals used, Amistar appeared to be the best for its performance in controlling seed borne pathogens as well as increasing pod yield and kernal weight of peanut. Amistar can successfully be used by the peanut growers.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

Effect of seed treatment with Bion (Benzothiadiazole), Amistar (azoxystrobin) and Vitavax-200 (Carboxin) on germination, prevalence of seed borne fungi, seedling mortality, tikka incidence and its severity, growth parameters and yield contributing characters of peanut were investigated in the laboratory and field laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh during the period of July 2002 to May 2003. The two selected varieties of peanut viz. Dhaka 1 and Jhinga badam were used. Seed health test by blotter method revealed that the seeds of peanut var. Dhaka 1 yielded *Aspergillus niger* (19.0%), *A. flavus* (18%), *Sclerotium rolfsii*(2.33%), *Fusarium* spp. (5.0%), *Rhizoctonia solani* (2%), *Macrophomina phaseolina* (3.0%) and *Penicillium* spp. (1.67%) and seeds of Jhinga badam yielded *Aspergillus niger* (19.3%) *A. flavus* (12.33%), *S. rofsii* (0.67%), *Fusarium* spp. (2.67%), *R. solani* (2.33%), and *M. phaseolina* (3.33%) and *Penicillium* spp. (2.0%). Seed treatment with Bion (0.005% and 0.01%), Amistar (0.05% and 0.1%) and Vitavax-200 (0.3% of seed weight) reduced prevalence of seed borne fungi on blotter. Amistar and Vitavax-200 showed best performance in controlling seed borne fungi. Bion (0.01%), Amistar (0.05%) and Vitavax-200 (0.3% of seed weight) completely inhibited the prevalence of seed brone *Sclerotium* and *Fusarium* of peanut var. Dhaka 1 and Jhinga badam. Moreover, Amistar (0.1%) and Vitavax-200 (0.3% of seed weight) strongly inhibited the prevalence of seed borne *Rhizoctonia solani, Macrophomina phaseolina* and *Penicillium* spp.

Effect of different treatment on germination of peanut seed var. Dhaka 1 and Jhinga badam on blotter did not differ significantly. Challenge test with *Aspergillus niger* showed that none of the tested chemicals had the ability to protect crown rot

(*Aspergillus niger*) of peanut. Challenge test with *Sclerotium* rolfsii showed that Vitavax-200 exerted best performance to control *Sclerotium rolfsii* and increased germination and decreased post emergence seedling mortality, whereas Amistar showed better performance to control *Fusarium oxysporum* and increased germination and decreased post emergence death of seedlings.

Vitavax-200 gave better performance and increased germination and decreased post emergence mortality in both the peanut varieties under field condition. It was observed that Bion showed better performance regarding tikka disease (*Cercospora arachidicola* and *Cercosporidium personatum)* in reducing number of diseased leaflets /plant and incidence of leaf infection at first counting (110 days after sowing). Amistar were found to be effective to reduce number of diseased leaflets/ plant, percent leaf infection and percent leaf area diseased. Bion has been found to increase pod yield/plant and kernal yield/plant by upto 27.06% and 32.33%, respectively over control, whereas Amistar increased pod yield/plant and kernal yield/plant of peanut var. Dhaka 1 and Jhinga badam by upto 69.1% and 90.41% over control, respectively. Seed treatments with Vitavax-200 increased pod yield/plant and kernal weight/plant var. Dhaka 1 and Jhinga badam by upto 39.47% and 52.36%, respectively over control.

The findings of the present study has clearly pointed out that among the chemicals used, Amistar appeared to be the best for its performance in controlling seed borne pathogens as well as increasing pod yield and kernal weight of peanut. Amistar can successfully be used by the peanut growers.

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