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INTEGRATED DISEASE MANAGEMENT OF SUMMER GROUNDNUT

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Abstract

Integrated Disease Management of six different treatment combinations (T_0 = Control, T_1 = Application of Neem oil extract solution (1: 10 dilution) started from 10 days after sowing (DAS) at 10 days interval, T_2 = Application of Dithane M-45 @ 0.2% started from 10 DAS and at 10 days interval, T_3 = Application of Sumithion @ 0 .3% started from 10 DAS at 10 days interval, T_4 = Integration of Dithane M-45 + Sumithion , T_5 = Integration of Dithane M-45 + Sumithion + Neem oil extract) were performed with groundnut varieties (V_1: Dhaka-1, V_2: Binachinabadam-2 and V_3: Binachinabadam-3) to measure the effectiveness of the disease control treatments as well as to get the maximum economic return. Among the treatments, T_5 gave the best result along with all three varieties. Treatment T_5 gave highest yield of 3061.31 kg ha^{-1} in Binachinabadam-3. The second best performance was recorded at T_4 treatment which received Dithane M-45 + Sumithion and yielded 3001.50 kg ha^{-1} in Binachinabadam-3. Other yield contributing parameters were also found significantly higher in Binachinabadam-3. Benefit cost ratio (BCR) was highest 2.00 at the combinations of T_5V_3 and T_5V_2 followed by T_3V_3 and T_3V_2.

Keywords: Integrated Disease Management, groundnut, variety, benefit cost ratio

Introduction

Groundnut *(Arachis hypogoea* L.) belongs to the family Papilionaceae, occupies an important position among all the oil seed crops grown in tropical and sub-tropical countries of the world (Higgings, 1951). Groundnut occupies the fourth place in the world among the oilseed crops both in area and production next to soybean, sunflower and cotton (Weiss, 1983). Groundnut is a multipurpose and highly nutritious crop. Its kernel contains 48 to 50% edible oil compare to 30 to 35% in other oilseed crops grown in Bangladesh (Khaleque, 1986). Groundnut is an excellent source of vitamin B and it also contains a considerable amount of vitamin E and small amount of vitamin A and D. Groundnut stands first among the oilseed crops in Bangladesh in terms of yield ha^{-1} but it is fourth in respect of area and production (Pramanik, 1995). It covers 7.59% (29149.80 ha) of the total area (384210.53 ha) occupied by edible oilseed crops and 10.96% (32000 metric ton) of the total production (292000 metric ton) of edible oil (Anonymous, 2001). The average yield of oilseeds is 0.81 metric ton ha^{-1} whereas the average yield of groundnut is 1.09 metric ton ha^{-1} (Anonymous, 2001). So the production of groundnut can be increased by selecting high yielding varieties coupled with proper crop and disease management.

There are many constraints responsible for low yield of groundnut such as biotic and abiotic factors. Among the biotic factors disease plays a vital role in reducing groundnut yield. The world record indicates that groundnut has been suffering from 60 different diseases (Westcott, 1947) of which 21 are known to occur in Bangladesh (Talukder, 1974; Anonymous, 1983; Ahmed and Hossain, 1985). Among the diseases Tikka (*Cercospora arachidiola* and *Cercosporidium personatum*), Stem and pod rot (*Sclerotium rolfsii*), root knot (*Meloidogyne javanica*) etc. have high incidence, distribution and detrimental effect on yield (Talukder, 1974; Fakir, 1980; Khaleque, 1986; DAE, 1985; Chester, 1950). Intensity of disease incidence in Bangladesh is more severe during the kharif reason than in the rabi season. It is difficult to achieve satisfactory control with spray fungicides during kharif season because of frequent and sometimes continuous wet spell prevailing in Bangladesh. So, management of the diseases may integrate cultural practices, cultivar resistance and fungicide usage. The improved package produced 25% higher

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pod yield (2.89 t ha^{-1}) than farmers practice and the cost of producing 1 kg groundnuts with the improved package was 29% lower than that of farmers package (Nguyen *et al*. 1996).

Despite the widespread occurrence and the disease induced significant yield reduction throughout the groundnut growing countries of the world, its control has not been very successful. However, no single method of disease control is totally effective against diseases. To minimize losses due to disease, integration of several methods of disease control on groundnut have been suggested. Integrated Disease Management (IDM) may be seeking a number of control methods integrated in a rational way to provide long term protection and to be found out for safe oil seed crops production. Such effort was made in the study by employing two different components of plant disease control (botanical and chemical control) with the following objectives; 1) to observe the performance of three summer groundnut varieties in terms of health and yield, 2) to observe the response of the test cultivars to the treatments individually and integrated in term of health and production, and, 3) to develop a package for the groundnut growers of the locality for profitable production of healthy groundnuts.

Materials and Methods

In pursuance of the objectives the research work was conducted at the Plant Pathology field laboratory, Bangladesh Agricultural University, Mymensingh which is belonging to the old Brahmaputra Floodplain, Agro-Ecological Zone. The soil was sandy loam in texture having pH value of 6.5. The climate of the experimental location was characterized by wet summer and dry winter. There was a relatively high temperature from March to October 2006.

Three groundnut (*Arachis hypogoea* L.) varieties, namely Dhaka-1, Binachinabadam-2 and Binachinabadam-3 were used for the study and collected from the Genetics and Plant Breeding Division of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh. These varieties have been released as summer and winter type and could be grown in the Kharif season in Bangladesh. Dhaka-1 was considered as V_1, Binachinabadam-2 as V_2 and Binachinabadam-3 as V_3. The experiment was done by the following six treatments combinations; such as, T_0 = Control, T_1 = Application of Neem oil extract solution (1: 10 dilution) starting 10 days after sowing @ 10 days interval, T_2 = Application of Dithane M-45 @ 0.2% starting 10 days after sowing and at 10 days interval, T_3 = Application of Sumithion @ 0 .3% starting from 10 days after sowing and at 10 days interval, T_4 = Integration of Dithane M-45 + Sumithion , T_5 = Integration of Dithane M-45 + Sumithion + Neem oil extract. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 replications. The size of individual unit plot was $2m^2 \times 1m^2 = 2m^2$. The seeds were sown in the plots at the rate of 120 kg ha^{-1} in lines, maintaining line to line distance of 25 cm and seed to seed 10 cm as recommended by Bangladesh Institute of Nuclear Agriculture (BINA). There were 4 lines in each plot and seed was drilled by hand on the small furrow made by lines. The intercultural operations were done in order to maintain the favourable condition for crop growth. Thinning and weeding were performed and irrigation was also done. Data was collected based on the following parameters from each plot:

i. Numbers of plants $plot^{-1}$
ii. % Healthy plants
iii. % Symptom (Cercospora leaf spot) bearing plants (Disease intensity)
iv. % Plant area infected (Disease severity)
v. Plant height (cm)
vi. Number of pod $plant^{-1}$
vii. Yield of pod $plot^{-1}$ (g)

The percentage of symptom bearing plants was recorded when the plants were at the age of 90 days using the following formula;

$$\text{Disease intensity} = (\text{Number of infected plants})/(\text{Total number of plants}) \times 100.$$

The percentage of plant area infected was recorded when the plants were at the age of 90 days using the following formula;

$$\text{Disease severity} = (\text{Total leaf area infected})/(\text{Total leaf area}) \times 100.$$

Statistical analysis

Analysis of variance of the parameters was done by the use of RCBD programmed software. The mean values were compared by Duncan's Multiple Range Test (DMRT). Analyses were performed after transformation of percent data into arcsine ($\sin^{-1}\sqrt{x}$).

Results and Discussion

Interaction effect was found significant in terms of most of the parameters studied. Hence, results and discussion were made based on the interaction effect of varieties and disease control methods as follows.

Plant height

Interaction effect was found non-significant for plant height (Table 1). However, plant height ranged from 39.00 cm in V_3T_0 and V_3T_1 to 50.33 cm in V_1T_5.

Table 1. Interaction effect of variety and treatment on the number of plant plot^{-1}, percent healthy plant, percent symptom bearing plant, percent plant area infected, height of plant, number of pod plant^{-1}, yield of pod plot^{-1} and pod yield.

Variety × Treatment	Plant height (cm)	Number of plant plot^{-1}	Percent healthy plant	Percent symptom bearing plant	Percent plant area infected	Number of pod plant^{-1}	Yield of pod plot^{-1} (g)	Pod yield (kg ha^{-1})
V_1T_0	47.33	24.66 g	63.50 e	36.50 a	88.00 a	40.00 cd	494.87 g	2474.33 g
V_1T_1	47.66	25.66 fg	75.33 c-e	24.67 c-e	86.33 ab	40.66 bc	511.52 fg	2557.58 fg
V_1T_2	48.66	26.66 d-f	75.02 a-d	24.97 cd	84.33 de	40.66 bc	514.94 fg	2574.72 fg
V_1T_3	48.66	26.66 d-f	76.25 a-d	23.74 d-f	84.00 a-c	41.00 a-c	529.96 ef	2649.80 ef
V_1T_4	49.66	27.66 cd	75.92 a-d	24.07 d-f	81.33 b-d	41.66 ab	547.58 de	2736.22 de
V_1T_5	50.33	27.66 d	79.52 a-c	20.48 g	79.66 c-e	42.33 a	553.72 c-e	2825.53 cd
V_2T_0	42.00	26.00 ef	70.51 b-e	29.49 bc	84.00 a-c	35.33 j	517.86 fg	2589.30 fg
V_2T_1	42.66	27.33 d	75.61 a-d	24.38 d-f	83.66 a-c	35.66 ij	544.22 be	2721.12 de
V_2T_2	43.66	27.00 de	80.27 ab	19.72 e-g	80.66 b-d	36.66 g-j	562.37 cd	2811.83 cd
V_2T_3	44.00	29.00 b	77.03 a-d	22.97 d-f	80.00 b-d	37.33 f-i	596.69 ab	2983.47 ab
V_2T_4	45.00	29.66 ab	74.17 d	25.82 cd	78.33 c-e	37.00 f-j	587.69 ab	2938.45 a-c
V_2T_5	45.33	30.66 a	82.61 a	17.38 g	77.00 c-e	37.66 e-h	610.65 a	3053.25 a
V_3T_0	39.00	25.66 fg	67.53 de	31.79 ab	82.00 a-d	36.00 h-j	530.19 ef	2650.97 ef
V_3T_1	39.00	27.00 de	76.53 a-d	23.46 d-f	81.33 b-d	36.66 g-j	548.53 de	2742.67 de
V_3T_2	40.00	27.33 d	79.27 a-c	20.72 d-g	79.00 c-e	38.00 e-g	576.64 bc	2883.20 bc
V_3T_3	40.33	28.66 bc	75.57 a-d	24.42 d-f	76.66 c-e	39.00 de	596.83 ab	2984.13 ab
V_3T_4	41.33	29.33 b	77.28 a-d	22.72 d-f	75.33 de	37.33 e-i	600.30 ab	3001.50 ab
V_3T_5	41.66	30.66 a	80.46 a	19.53 fg	72.00 e	38.66 d-f	612.26 a	3061.32 a
LSD (> 0.05)	NS	0.966	5.493	2.975	4.592	1.487	23.87	119.5

T_0 = Control, T_1 = Application of Neem oil extract, T_2 = Application of Dithane M-45, T_3 = Application of Sumithion, T_4 = Application of Dithane M-45 + Sumithion, T_5 = Application of Neem oil extract + Dithane M-45 + Sumithion, V_1 = Dhaka -1, V_2 = Binachinabadam -2 and V_3 = Binachinabadam -3 and NS = Non significant.

Number of plant plot^{-1}

Number of plants plot^{-1} was found significant for interaction effect (Table 1). The highest number of plant was found 30.66 under T_5 (Neem oil extract + Dithane M-45 + Sumithion) and T_4 (Dithane M-45 + Sumithion) in the varieties V_2 and V_3 which was statistically similar to the combination of V_2T_4 (29.66). The lowest number of plant (24.66 plot^{-1}) was found under the combination of V_1T_0 which was statistically similar to V_1T_1 (25.66 plot^{-1}) V_3T_0 (25.66 plot^{-1}). Similar results also reported by Razzaque and Hamid (1994).

Percent healthy plant

The interaction effect was found significant for percentage of healthy plant (Table 1). The highest percentage of healthy plant was recorded 82.62 under T_5 (Integration of neem oil extract + Dithane M-45 + Sumithion) in V_2

which was statistically similar to the combination of V_3T_5 (80.46). The lowest percentage of healthy plant was found 63.50 under the combination of V_1T_0. Similar result was supported by Razzaque and Hamid (1994).

Percent symptom bearing plant

The percentage of symptom bearing plant was found significant (Table 1). The highest percentage of symptom bearing plant (36.50) was obtained in the combination of V_1T_0 which was statistically similar to the combination of V_3T_0 (31.79). The lowest percentage of symptom bearing plant (17.38) was obtained in V_2T_5 which was statistically similar to the combination of V_3T_5 (19.53) and V_1T_5 (20.48). Similar result was supported by Razzaque and Hamid (1994), and Bari and Mian (1979) and reported that 70-80% reduction in leaf spot disease incidence by applying Dithane M-45.

Percent plant area infected

The interaction effect was found significant for percentage of plant area infected (Table 1). The highest percentage of plant area infection was found 88.00 in the combination of V_1T_0 which was statistically similar to the combination of V_1T_1 (86.33). The lowest percentage of plant area infection (72.00) was found under the integrate application of neem oil extract + Dithane M-45 + Sumithion (T_5) in V_3 which was statistically similar to the combination of V_3T_5 (75.33). This result was supported by Hossain and Mian (1981) who reported that 18.39% disease reduction was obtained by applying 3lb/100 gallons (3600 ppm) of Dithane M-45. Bari and Mian (1979) also reported that 70% reduction in leaf spot disease incidence by applying the integration of Dithane M-45 + Sumithion + neem oil extract.

Number of pod plant^{-1}

The number of pod plant^{-1} was found significant (Table 1). The highest number of pod plant^{-1} was found 42.33 under T_5 (Neem oil extract + Dithane M-45 + Sumithion) inV_1 which was statistically similar to V_1T_4 (41.66; Dithane M-45 + Sumithion) and the lowest number of pod plant^{-1} was found 35.33 under V_2T_0 which was statistically similar to the combination of V_2T_1 (35.66). Similar results were also obtained by Rattan and Kang (1984).

Yield of pod plot^{-1}

The interaction effect was found significant on the yield of pod plot^{-1} (Table 1). The highest yield of pod was found 612.26 g under T_5 (Neem oil extract + Dithane M-45 + Sumithion) in V_3 which was statistically similar to the combination of V_3T_4 (600.30 g), V_3T_3 (596.83 g). The lowest yield of pod was found 494.87 g in the combination of V1T0 which was statistically similar to the combination of V_1T_1 (511.52 g), V_1T_2 (514.94 g) and V_2T_0 (517.86 g). Similar results were also obtained by Rattan and Kang (1984) who reported that Dithane M-45 and Sumithion combined application effectively controlled leaf spot and also reported that yields were 67.7% higher.

Table 2. Benefit cost ratio (BCR) analysis of different treatments of groundnut varieties.

Treatment	Dhaka-1	Binachinabadam-2	Binachinabadam-3
T_0	-	-	-
T_1	1.80	1.91	1.93
T_2	1.78	1.94	1.99
T_3	1.77	1.99	1.99
T_4	1.81	1.94	1.98
T_5	1.85	2.00	2.00

Total yield

The interaction effect of total yield was found significant (Table 1). The highest pod yield was found 3061.32 kg ha^{-1} under T_5 (Neem oil extract + Dithane M-45 + Sumithion) in V_3 which was statistically similar to the combination of V_3T_4 (3001.50 kg ha^{-1}), V_3T_3 (2984.13 kg ha^{-1}) and V_2T_3 (2983.47 kg ha^{-1}). The lowest yield 2474.33 kg ha^{-1} was found under V1T0 which was statistically similar to the combination of V_1T_1 (2557.58 kg ha^{-1}), V_1T_2

(2574.72 kg ha^{-1}) and V_2T_0 (2589.30 kg ha^{-1}). These results are in full conformity with Badwal and Singh (1973), Patil and Bhapker (1987), and Reddy and Gupta (1992).

Benefit cost ratio (BCR)

Benefit cost ratio presented in Table 2 revealed that the maximum benefit cost ratio 2.00 was observed in the treatment T_5 along with both Binachinabadam-2 and Binachinabadam-3 varieties. Actually, the disease control treatments of T2, T3, T4 and T5 in Binachinadadam-3 gave more or less similar BCR ranged from 1.98 to 2.00. Dhaka-1 in combination with all disease control treatments gave lower BCR values ranged from 1.77 to 1.85.

The obtained results are applicable for BAU Farm area at Mymensingh. These results do not reflect the performance of neither varieties nor the treatments for the whole country as groundnut is a very environment sensitive crop. Therefore, it may be concluded that the variety Dhaka-1, Binachinabadam-2 and Binachainabadam-3 which may be cultivated in and around BAU by providing foliar application of Neem oil extract, Dithane M-45 and Sumithion at a proper dose either independently or in combination.

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