http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 5(7): 752-754, 2002

Field Evaluation of Integrated Management Practices on Garlic Production

[1]M.R. Karim, [1]S.M. Asaduzzaman, [2]F. Islam, [1]M.A. Islam, [3]S.M.N. Islam and [1]Q. Naher
[1]On-Farm Research Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh
[2]On-Farm Research Division, Bangladesh Agricultural Research Institute, Pabna, Bangladesh
[3]On-Farm Research Division, Bangladesh Agricultural Research Institute, Khulna, Bangladesh

Abstract: Two types of fungicides and their mixture viz. Rovral, Ridomil and Rovral+ Ridomil along with five combinations of different fertilizers were tested to find the best integrated package method for successful garlic production. The highest fertilizer dose especially nitrogenous fertilizer F_5 (200, 166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and Cow dung ha^{-1}) produced the highest bulb yield of garlic (6.36 and 7.89 t ha^{-1} during 1997 and 1998 respectively), which was statistically similar with the yield of F_4 (6.28 and 7.57 t ha^{-1} during 1997 and 1998 respectively) where 150, 166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and CD ha^{-1} were applied. The mixed application of Rovral and Ridomil was better in case of garlic bulb yield (6.44 and 7.79 t ha^{-1} in 1997 and 1998 respectively). The incidence of purple blotch was significantly reduced (1.6 and 1.7 score in 1997 and 1998 respectively) by mixed application fungicide. The interaction between fertilizer and fungicide had no significant effect on garlic yield.

Key words: Garlic production, integrated approach, purple blotch, rovral, ridomil

Introduction

Garlic (*Allium sativum*) is the second spices crop in Bangladesh and is widely used of the cultivated *Allium* after onion (Pursedlove, 1985). It is grown in an area of 12,955 hectares with an average yield of 3.08 t ha^{-1} (BBS, 1998). This yield is very low as compared with that of the world average (6.3 t ha^{-1}) (Anonymous, 1987). Thus, Bangladesh has to import garlic each year to meet up the domestic needs. The low yield is mainly due to lack of proper management practices. So, there is a scope of increasing the yield by improving the existing management practices. Rahman and Talukder (1986) and Shahidullah *et al.* (1990) reported that the production of garlic could be increased by improving the method of cultivation e.g. use of chemical fertilizers (especially nitrogenous), proper use of pesticide and fungicide against pest and diseases etc. Mondal *et al.* (1991) stated that judicious use of nitrogenous fertilizer is important for leaf as well as bulb production. There is no such national recommendation for nitrogenous fertilizer or package of fertilizer for successful production and there is a debate on it (Aiyer, 1980). Possibly this variation of nitrogen doses was due to the variation in soil and climatic conditions of experimental sites.

It has been observed that a substantial area of garlic is damaged by purple blotch (*Altamaria porri*) in Bangladesh every year. It is urged that purple blotch infestation is often increased with the application of increasing amount of nitrogenous fertilizers. On the contrary, Mondal *et al.* (1991) stated that higher level of nitrogenous fertilizers had ensured maximum bulb yield of garlic. Some works have already been done on application of nitrogenous fertilizer of garlic but no such work has yet been done against purple blotch control as well as fertilizer application. Thus, the present study has been designed to assess the effect of integrated application of nitrogenous fertilizer and fungicide against purple blotch management and on the bulb yield of garlic.

Materials and Methods

The experiment was conducted at Agricultural Research Station, Pabna under Sara highland soil series during rabi seasons of 1996-97 and 1997-98. The soil belongs to agro-ecological zone (AEZ) 11a of high Ganges river floodplain. The initial soil status of the experimental site were as follows:

Year	pH	OM(%)	Total N(%)	P(ppm)	S(ppm)	K(meq/ 100 g soil)
1996-97	7.2	1.05	0.06	18	14	0.13
1997-98	7.1	0.98	0.06	18	16	0.15

In the year 1997-98, the OM(%) slightly reduces but K and S slightly increased. Except potassium, the nutrient status of phosphorus and sulphur were in the same and above the critical level. The organic matter percentage was almost similar in both the years.

The experiment was laid out in split plot design with 3 replications. The unit plot size was 4 x 3 m^2. The cloves of local variety were sown on November 28 and November 20 in 1996 and 1997 respectively by maintaining a spacing of 20 and 10 cm between rows and plants respectively. The crop was harvested during early March in both the years.

Two types of fungicides viz. (I) Rovral-50 WP [0.2%], {(contains 500 g Iprodine kg^{-1}) 3-(3,5-dichlorophenyl) -N- (1 methyl ethyl)-2,4 dioximidazolidine carboxamide}, (2 g mixed with 1 L of water and then sprayed) and (ii) Ridomil MZ-72 [0.2%], {(contains 720 g Mancozeb kg^{-1}) N-(2,6 dimethyl phenyl) N-(methoxyacetyl-alanine methyl ester)}, (2 g mixed with 1 L of water and then sprayed) were tested along with their mixture to control purple blotch. Four main plots received following fungicide treatments:

1) Control (No fungicide), {normal water sprayed at the same day and same manner},
2) Rovral,
3) Ridomil,
4) Rovral + Ridomil.

Five combinations of different fertilizers were assigned in sub-plots such as:

1) 45, 166 and 37 kg N, P_2O_5 and K_2O ha^{-1} respectively (F_1) [Farmers dose],
2) 50,166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and CD ha^{-1} respectively (F_2),
3) 100,166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and CD ha^{-1} respectively (F_3),
4) 150,166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and CD ha^{-1} respectively (F_4),
5) 200,166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and CD ha^{-1} respectively (F_5).

One half of N and full doses of P, K, S and decomposed cow dung (CD) were applied as basal. Three times weeding were done on 30, 45 and 70 days after sowing. The crop was fertilized with rest half of urea as top dress after 30 days of sowing with subsequent weeding by small hand hoe. Two irrigations were made on 25 and 65 days after sowing. Fungicides (0.2% solution) were sprayed three times (40, 55 and 70 days after sowing) as preventive measure to control purple blotch. In the control plot only water was sprayed in the same manner of fungicides.

Food and Agriculture Organization. randomly pre-selected plants of each sub-plot. Plant height was recorded before 30 days of harvest. Bulb yield was recorded from three spots of 1x1 m^2 i.e. 3 m^2 area. The recorded data was statistically analyzed by a statistical software package (IRRISTAT 3.1).

Simple costs and returns (economic) analysis was done for the tested treatments. Variable cost items included only the expenses for materials (fertilizer and fungicide). The fixed costs (land rent/tenure, labour, seed, land preparation, intercultural operation etc.) were not included. Return from the produce (as per market price of that time) of all the treatments were calculated as the product of the yield and its unit price. All production returns were added as the total gross returns. Gross margin was computed as the difference between gross return and variable cost (expenses of fertilizer and fungicide). Data was taken from two cropping seasons (1996-97 and 1997-98).

Results and Discussion

Effect of fungicide: Fungicides did not show any significant effect on plant height but it had an effect on bulb diameter in 1996-97. In the following year (1997-98) fungicides showed no effect on any parameter with the exception of bulb yield which was significantly influenced (Table 1). The higher bulb yield (6.44 and 7.79 t ha^{-1} in 1996-97 and 1997-98 respectively) were obtained from mixed application of Rovral and Ridomil (Rovral+ Ridomil), which was followed by single application of Rovral (6.31 and 7.30 t ha^{-1} 1996-97 and 1997-98 respectively) and then Ridomil (5.88 and 6.98 t ha^{-1} 1996-97 and 1997-98 respectively). The control plot produced the least bulb yields in both years (5.32 and 6.58 ha^{-1} 1996-97 and 1997-98 respectively). The incidence of purple blotch was controlled by spraying fungicides. The best performance was observed by spraying Rovral + Ridomil at 15 days interval and recording the lowest disease rating 1.6 and 1.7 in the year 1996-97 and 1997-98 respectively. This rating was scored by the eye estimation of 3 spots (1 x 1 m^2) of each sub-plots.

The disease rating was identically followed by the application of Rovral or Ridomil singly in both years. Control (no fungicide) treatment showed significantly highest disease incidence (3.4 and 4.3 in 1997 and 1998 respectively) in garlic (Table 1).

The above results regarding the chemical control of purple blotch are to some extent agreed with the findings of some works done in Bangladesh and other countries. Hoq *et al.* (1994) conducted an experiment with four fungicides (Rovral, Dithane M-45, Cupravit and Antacol) for the control of purple blotch of garlic in the laboratory as well as field. In the field, all fungicides reduced disease severity but Rovral recorded the lowest disease incidence. Sastrahidayat (1995) conducted an experiment in Malang (Indonesia) on integrated control of purple blotch of garlic in the laboratory, green house and field. The application of Difenoconazole 0.8 ml/litre with transparent polythene sheets and combination of these treatments inhibited growth of the pathogen in the field. In an other trial, Borkar *et al.* (1995) reported that Mancozeb reduced disease intensity of onion by 6%, yield increased by 11% and also had a higher benefit cost ratio than other tested fungicides (Chlorathalonil, Captafol and Carbendazim). In the same year, Upadhyay and Tripati (1995) concluded that all fungicides significantly reduced disease intensity of garlic and gave increased yields over control but the best results were obtained with Captafol.

Effect of fertilizer: Different fertilizer doses had significant effect on the yield and bulb diameter in both years (Table 2). The plant height was not influenced by the increased levels of fertilizer in 1996-97 but it was significantly increased with the increased fertilizer in 1997-98, which is well agreed with the findings of Thomson and Troech (1979). They have reported that the nitrogen deficiency was the main cause of stunted plant growth of garlic. The highest plant height (59.8 cm) was recorded from treatment F_5 that was identical to treatment F_4 (58.4 cm) in 1997-98 (Table 2). The plant height of F_3 (52.6 cm) was significantly lowest in the year 1997-98, although there was not abyss of numeric difference. It might be due to the sampling of measured plants. In both years, bulb diameter influenced by the increase in fertilizer dose (Table 2). In the year 1996-97, the significantly highest bulb diameter was recorded from the treatment F_5 (4.3 cm) and it was identical with F_4 (4.2 cm). On the other hand (during the year 1997-98), the bulb diameter of F_5 (4.5 cm), F_4 (4.4 cm) and F_3 (4.4 cm) were statistically identical, which was differed with F_1 and F_2 (4.2 cm respectively). Photosynthetic accumulation in the cloves might have tended to produce larger bulb diameter and it was due to higher intake of nitrogenous fertilizer. This result is also in agreement with that of Mondal *et al.* (1991). The bulb yield was increased with the increased doses of fertilizer especially N-fertilizer. Similar results were also reported by Rahman and Talukder (1986) and Shahidullah *et al.*

Table 1: Effect of fungicides on the yield, yield attributes and disease rating of garlic (1996-97 and 1997-98)

Treatments	Plant height (cm)		Bulb diameter (cm)		Bulb yield (t ha^{-1})		Diseases score	
	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98
Control	46.9 a	58.0 a	3.8 c	4.3 a	5.32 c	6.58 d	3.4 a	4.3 a
Rovral	49.0 a	54.3 a	4.1 ab	4.4 a	6.31 a	7.30 bc	2.4 ab	3.2 bc
Ridomil	47.7 a	54.3 a	4.0 bc	4.3 a	5.88 b	6.98 c	2.1 ab	2.4 c
Rovral+ Ridomil	51.3 a	55.1 a	4.2 a	4.3 a	6.44 a	7.79 a	1.6 c	1.7 d

Figures in a column bearing same letter(s) are non-significant

Note: Diseases score, 1 = 15 to 30%, 2 = 30 to 45%, 3 = 45 to 60%, 4 = 60 to 75% and 5 = 75 to 80% leaves infested by the purple blotch (*A. porri*).

Table 2: Effect of fertilizers on the yield and yield attributes of garlic (1996-98)

Treatments	Plant height (cm)		Bulb diameter (cm)		Bulb yield (t ha^{-1})	
	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98
F_1	46.7 a	53.8 b	3.8 c	4.2 b	5.57 d	6.55 d
F_2	49.1 a	53.8 b	3.7 c	4.2 b	5.76 c	6.76 c
F_3	49.4 a	52.6 c	4.0 b	4.4 a	5.99 b	7.24 b
F_4	49.0 a	58.4 a	4.2 a	4.4 a	6.28 a	7.57 b
F_5	49.6 a	59.8 a	4.3 a	4.5 a	6.36 a	7.89 a
CV (%)	7.5	11.5	3.1	8.7	5.9	8.9

Figures in a column bearing same letter(s) are non-significant

F_1 = 45, 166 and 370 kg N, P_2O_5, K_2O, kg ha^{-1} (Farmers' dose)

F_2 = 50, 166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and Cow dung kg ha^{-1}

F_3 = 100, 166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and Cow dung kg ha^{-1}

F_4 = 150, 166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and Cow dung kg ha^{-1}

F_5 = 200, 166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and Cow dung kg ha^{-1}

Table 3: Partial budget analyses for MRR (%) of garlic as influenced by the integrated application of fungicide and fertilizer (average of two seasons 1996-97 and 1997-98)

Treatments	Garlic yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Variable cost (VC)* (Tk. ha^{-1})	Gross margin over VC (Tk. ha^{-1})	Marginal gross margin (Tk. ha^{-1})	Excess cost* (Tk. ha^{-1})	MRR (%)
No Fungicide							
F_1	5.76	115200	7305	107895	-	-	-
F_2	5.75	115000	8355	106645	-1250	1050	-19
F_3	5.89	117800	8905	108895	5450	550	409
F_4	6.19	123800	9455	114345	5450	550	991
F_5	6.34	126800	10005	116795	2450	550	445
Rovral							
F_1	6.11	122200	8685	113515	-	-	-
F_2	6.50	130000	9765	120265	6750	1050	643
F_3	6.78	135600	10285	125315	5050	550	918
F_4	7.15	143000	10835	132165	6850	550	1245
F_5	7.25	145400	11385	134015	1850	550	336
Ridomil							
F_1	5.80	116000	8565	107435	-	-	-
F_2	6.04	120800	9615	111185	3750	1050	357
F_3	6.40	128000	10165	117835	6650	550	1209
F_4	6.83	136600	10715	125885	8050	550	1464
F_5	7.03	140600	11265	129335	3450	550	627
Rovral + Ridomil							
F_1	6.16	123200	11205	111995	-	-	-
F_2	6.75	135000	12255	122745	10750	1050	1024
F_3	7.38	147600	12805	134795	12050	550	2190
F_4	7.53	150600	13355	137245	2450	550	445
F_5	7.86	157200	13905	143295	6050	550	1100

The treatment F_2 under no fungicide was dominated over other treatments.
*Variable cost (VC) = Cost of fertilizer and fungicide only.
Excess cost = Cost increased due to higher dose over the previous dose.
Tk. = Taka (the official currency of Bangladesh), [1 US $ = Tk. 45.00 during March, 1998].
Input price (Tk. kg^{-1})
Urea - 5.00, TSP - 11.25 , MP - 7.40, Gypsum- 2.55, Cow dung - 1.00, Rovral - 1150.00 and Ridomil - 1050.00,
Output price (Tk. kg^{-1})
Garlic bulb - 20.00 (as per local market price (during harvest time i.e. March, 1998).

(1990) where they reported that the production of garlic increased by improving the method of cultivation including the use of higher amount of nitrogenous fertilizer. However, the higher yield of garlic (6.36 and 7.89 t ha^{-1} during 1996-97 and 1997-98 respectively) was obtained from the highest amount of N-fertilizer (200 kg ha^{-1}). It was followed by the identical yield (6.28 and 7.57 t ha^{-1} 1996-97 and 1997-98 respectively) obtained from 150 kg N ha^{-1} in 1996-97 and 1997-98 respectively. The treatments F_5 and F_4 showed higher bulb yield due to higher bulb diameter resulting from higher doses of N-fertilizer. The lowest bulb yield (5.57 and 6.55 t ha^{-1} in 1996-97 and 1997-98 respectively) was recorded from the farmers' dose. In general the yield of garlic was lower in 1996-97 than in 1997-98.

Interaction between fungicide and fertilizer level: The interaction effect of fungicide and fertilizer was not significant in both years. The incidence of purple blotch significantly reduced by spraying fungicide (Rovral + Ridomil) but higher yield was obtained from higher doses of fertilizer with fungicide (Rovral + Ridomil) in both years.

Cost and return: Average cost and return analyses revealed that the highest gross return (Tk.1,57,200 ha^{-1}) and gross margin (Tk. 1,43,295 ha^{-1}) were obtained from treatment F_5 integrated with the application of Rovral + Ridomil (Table 3). Partial budget analyses also shows that the maximum marginal rate of return (MRR) of 2190% obtained from F_3 when Rovral and Ridomil sprayed in mixed way. This 2190% MRR means if a farmer is able to spend additional Tk. 100 ha^{-1} for fungicide and fertilizer then he/she could earn additional Tk. 2190 ha^{-1}.

Nitrogen is one of the key elements for increasing the garlic yield and mixed application of Rovral + Ridomil could further increase the production by suppressing purple blotch disease. Considering the above result and foregoing discussion, application of 200,166,200,20 and 1000 kg N, P_2O_5, K_2O, S and CD ha^{-1} when integrated with Rovral + Ridomil is the best management approach for higher garlic production but F_3 (100,166, 200, 20 and 1000 kg N, P_2O_5, K_2O, S and Cow dung ha^{-1} respectively) with the application of Rovral alone could give the highest marginal rate of return (MRR%).

References

Aiyer, A.K.Y.N., 1980. Field Crops of India (1st ed.). Bangalore Pub. Co. Ltd. Bangalore, pp: 326-330.

Anonymous, 1987. Yearbook, Food and Agriculture Organization Production Vol., 41, pp:192.

Borkar, S.G. and B.S. Patil, 1995. Chemical control of purple blotch of onion. Indian J. Mycol. Pl. Pathol., 25: 288-289.

Hoq, M.I., P.K. Malakar and M.S. Nahar, 1994. Chemical control of leaf blotch of garlic. Bangla. J. Sci. Ind. Res., 29: 157-161.

Mondal, M.F., M.H.R. Pramanik and M. Abdus Salam, 1991. Effect of Urea-N on growth and yield of garlic (*Allium sativum* L.) under irrigated and rainfed condition. Bangla. Hort., 19: 1-6.

Pursedlove, J.W., 1985. Tropical Crops Monocotyledons. Longman Group Ltd. England, pp: 57.

Rahman, A.K.M. and M.R. Talukder, 1986. Influence of date of planting and plant spacing on the growth and yield of garlic. Bangla. J. Agric., 11: 12-19.

Sastrahidayat, I.R., 1995. Integrated control of purple blotch (*A. porri)* diseases on garlic. Agrivita, 18: 36-41.

Shahidullah, M.F., Huq. M.A. Karim and P.K. Mondal, 1990. Influence of NPK on the growth, yield attributes and bio-chemical parameters of garlic. Bangla. J. Agric. Res., 15: 11-15.

Thomson, L.M. and F.R. Troech, 1979. Soils and Soil Fertility. Tata McGraw-Hill Pub. Co. Ltd. New Delhi-110020, pp: 235-236.

Upadhyay, J. and K.C. Tripati, 1995. Field evaluation of fungicides against purple blotch *(A. porri)* of onion (*A. cepa*) seed crop. Recent Hort., 2: 153-155.