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 6 (14): 1243-1246, 2003
ISSN 1028-8880

Effect of Manure and Fertilizers on the Growth and Yield of Potato

A.B. M.Sharif Hossain, [1]M.A. Hakim and Justus M. Onguso
Laboratory of Horticulture, Faculty of Agriculture,
Ehime University, 3-5-7 Tarumi, Matsuyama shi 790-8566, Japan
[1]Bangladesh Agriculture Research Institute,
Horticulture Research Centre, Joydebpur, Gazipur, Bangladesh

Abstract: A field experiment was carried out to study the effect of manure and fertilizers on the growth and yield of potato in the village Narayanpur under Small Scale Water Resource Sector Development Project (SSWRDSP), Local Govt. Engineering Department, Khulna, Bangladesh. Potato was grown with different combination of manures and fertilizers or without combination. The highest plant height was 71.2 cm and lowest was 46.2 cm at 100 Days After Emergence (DAE) when potato was grown with cowdung + Mustard Oil Cake (MOC) +N+P_2O_5+K_2O and without manure and fertilizers respectively. However, maximum number of shoot per plant, no. of tuber per hill, yield of tuber per hill, tuber size in diameter were 5.0, 9.0, 365 gm and 14.5 cm respectively when potato was grown with cowdung +MOC+N +P_2O_5 + K_2O as compared to that of other combinations. In addition, the highest yield was 24.3 t ha^{-1} and percent infected plant by late blight disease was highest (20) when potato was grown with cowdung+MOC+N+P_2O_5+K_2O and without manures and fertilizers respectively. Whereas, lowest tuber yield was 12.6 t ha^{-1} and lowest percent infected plant was 7 in case of without manure and fertilizers and with cowdung +MOC+N +P_2O_5+K_2O, respectively.

Key words: Cowdung, mustard oil cake, N, P_2O_5, K_2O, potato, growth and yield

Introduction

Potato is native to the central Andean highland of south America. It belongs to the family solanaceae. It may be originated as a cultivated crop in Feru and Bolivia (Ahmad, 1977). It reached to Indo Bangla subcontinent in the 17th century (Ahmad, 1977) . It was grown in India as early as 1615. Potato is one of the leading food crop of the world. It produces more food per unit area than either rice or wheat (Ahmad, 1977 and B.B.S., 1996). Thomson and Kelly (1957) mentioned that potato is world leading vegetable crop along with the cheapest source of carbohydrate and furnishes appreciable amount of vitamin B_1 and vitamin C as well as source of mineral. Potato contains carbohydrate, protein, fats vitamin A and C of 88 k.cal, 20, 19.8, 0.1, 80 and 717 mg, respectively (Rashid, 1993).

Potato occupied world land of nearly 18191 thousand ha. with the total production of 265436 thousand metric ton and with the average yield of 14.6 t ha^{-1} (FAO., 1995). Potato is one of the most important vegetable and different food making crop in Bangladesh as well as other countries such as Holland, Poland, East Germany, Ireland, Cyprus, Japan, Netherlands England and U.S.A.

Potato contributes alone as much as 55% of the total annual vegetable production in Bangladesh (B.B.S., 1996). In the year 1991-92 potato was grown in an area of 125900 ha and the production was 1.36 million ton (B.B.S., 1996). Potato is a staple food in 44 developed countries in the world (Anonymous, 1991). Holland is one of the potato consuming country in the world. Average 400 kg potato is consumed per capita in Holland. In addition, Poland, East Germany, Ireland, Cyprus consume 200 kg potato per capita (Anonymous, 1991).

Growth and yield of potato varies from country to country because of different factors. Among those fertilizer and manures is one of the important factor. Siddique and Rashid (1990) stated that fertilizer doses of 95.2, N, 66.7, P_2O_5 and 145.2 kg K_2O along with 10 tons of cowdung per ha was found to be higher yield compared to that of without cowdung. Average yield per hectare has not been reached to an acceptable position so much in this Country as compared to that of other potato growing Countries of the world like USA 37.4 t ha^{-1}. (BBS, 1996; FAO., 1995). One of the main reason for such a poor yield (1.33 t ha^{-1}) in the poor fertility management i.e. improper use of manure and fertilizer for the cultivation (Islam *et al.,* 1982). There is no available information of the effect of manure and fertilizers on the growth and yield of potato. Very little work in this area has been done in Bangladesh. However literatures are available on work done abroad. Therefore the present piece of research work has been undertaken to evaluate the effect of manure and fertilizers on the growth, yield and quality of potato.

Materials and Methods

The experiment was located in the village Narayanpur under the area of SSWRDS Project, LGED, Khulna. Total area of land was 435 Sq. m. Individual plot size was 8 x 4.5 Sq. m. The experimental field was Ist opened with a power tiller on the 15th November, 1998. Four ploughing was made to get a good tilth. Weeds and other stubbles were removed from the field carefully. The land was exposed to the natural weathering for 10 days after ploughing. Last ploughing was done at the time of final land preparation. Manure fertilizations were applied at the rate of 10 t ha^{-1} cowdung 300 kg Mustard Oil Cake (MOC) 138kg N, 120 kg P_2O_5 130 kg (Rashid, 1993). The experiment was conducted in a Randomized Complete Block Design (RCBD) maintaining three replications were control (T_1) cowdung + mustard oil cake (MOC) (T_2), N + P_2O_5 + K_2O (T_3) and cowdung + MOC+N +P_2O_5+K_2O (T_4). The experimental filed was divided into three blocks. Each block was divided into four plots. Therefore, there was twelve plots in the field. Four treatments were randomly assigned in each block. The border space was 50 cm in all sides.

The potato cv. 'Multa' was used in this experiment 20 gm of cut tuber was used as seed. Pit to pit distance was 25 cm and row to row distance was 60 cm. Seeds were treated by formal dehyde to free from disease infection. Seeds were sown at the depth of 2.5cm of the soil. One seed was sown per pit following furrow method. Fifteen Days After Emergence (DAE) Ist earthing up was done and then 30 DAE 2nd earthing up was done. Irrigation was done three time. Weeding and other intercultural operations were done properly. After 100 DAE the potato tuber was harvested following harmpuling.

Recording of data was commenced from 10 DAE. The following parameters were recorded and statistically analyzed. The parameters are plant height, number of shoot per plant, shoot length, number of tuber per hill, size of tuber in diameter and length, tuber yield, number of late blight infected plant.

Results and Discussion

Plant height of potato at different Days After Emergence (DAE) was statistically significant (Table 1). Maximum plant height (71.2 cm) was observed at 100 DAE in T_4 compared to that of other treatments. Whereas, it was 46.2, 59.3 and 66.1 cm in T_1, T_2 and T_3, respectively. In case of T_1 maximum plant height was 5.4cm at 10 DAE. But it was 8.6, 10.2 and 11.3 cm in T_2, T_3 and T_4 respectively. At 30, 40, 50 and 60 DAE plant height was 14.1, 19.4, 25.5 and 33.6 cm in T_1. But it was observed 20.0, 27.3, 35.0 and 45.5 cm in T_2 at 30, 40, 50 and 60 DAE, respectively. It was always lower than that of T_3 and T_4.

Number of shoot per plant and shoot length were recorded (Table 2). Maximum no. of shoot per plant was 4.7 in T_4 and the minimum was 3.0 in T_1. Whereas, it was 3.7 and 4.2 in case of T_2 and T_3. The highest shoot length was 35.4 cm in T_4 and the lowest was 29.6 am in T_1. There is no statistically difference between T_3 and T_4 but there is difference between T_1 and T_4. Number of tuber per hill and yield of tubers per plant were statistically significance at different treatments (Table 3). The highest number of tuber (8.0) was recorded in T_4 and the lowest (5.0) was in T_1. In case of T_2 and T_3 it was 7.0 and 7.5, respectively. Yield of tuber per plant was 190 gm in T_1. It was recorded 285, 320 and 365 gm in T_2, T_3 and T4, respectively.

Size in both diameter and length were evaluated in different treatments (Table 3). Maximum size in diameter was 5.4 cm in T_4 and minimum was 4.2 cm in T_1. However, it was 4.5 and 5.0 cm in T_2 and T_3, respectively. Maximum length of tuber was 7.9 cm in T_4 and the minimum was 6.3 in T_1. Tuber yield (t ha^{-1}) was statistically different at different treatments (Fig. 1). Highest tuber yield was 24.3 ton per ha and the lowest was 12.6 in T_4 and T_1 respectively. However, it was 19.3 and 21.2 ton per ha respectively. Percent infected plant influenced by late blight disease at different treatments also recorded (Fig. 2). The highest and lowest percent late blight infected plant were 20 and 7 in T_1 and T_4, respectively. However, the trend was decreasing from T_1-T_4.

The result of the present research work evaluates that effect of manure and fertilizers have important impact on decreasing or increasing of growth, yield and quality of potato. Sharfuddin and Siddique (1985) stated that maximum plant height was varied from 60-90 cm. FAO. (1995), reported that yield was 9.78, 13.51, 25.90, 39.07, 31.86 and 230.37 t ha^{-1} in Bangladesh, Korea, Japan, Netherlands, England and USA, respectively. Miah *et al.* (1974) conducted an experiment with different combination of fertilizers of potato cv. eigenheimer and found that the maximum yield and number of large tuber observed when the crop was grown with N + P_2O_5 + K_2O. Effect of NPK fertilizer was also investigated by Madhikarmy (1978) in Napal. The average highest yield of potato became similar result to that of present research work which was 15.96 t ha^{-1}. when the crop was grown with farm yard manure (FYM) 180 kg N + 100 kg P_2O_5 +100 kg K_2O per ha as against out 3.61 t ha^{-1} without FAM and NPK. Different combination of NPK fertilizer on potato crop were tried by Sengupta and Karmakar (1986) in India. They got approximately similar result to present study and stated that potato cv. Kufri chandramukhi gave the highest tuber yield of 20.2 t ha^{-1}. with 120 kg N +100 kg P_2O_5 +100 kg K_2O per ha as compared with 8.2 t ha^{-1}. without NPK.

Shah and Ismail (1983) at Quetta in Pakistan conducted an experiment on the effect of different levels of NPK fertilizer on potato and reported that among the different combination of NPK fertilizer doses 125 kg N + 75 kg P_2O_5

Table 1: Plant height of potato at different Days After Emergence (DAE) as influenced by Different treatments

	Treatment			
DAE	T_1	T_2	T_3	T_4
10	5.4h	8.6h	10.2i	11.3h
20	9.8g	13.8g	15.5h	17.7g
30	14.1f	20.0f	22.3g	24.6f
40	19.4e	27.3e	29.5f	32.5e
50	25.5d	35.0d	38.2e	40.0d
60	33.6c	45.5c	50.5d	52.6c
70	38.1bc	51.2b	56.3c	59.3bc
80	42.5ab	55.0ab	60.5bc	64.5b
90	44.3a	58.2a	63.0ab	67.6ab
100	46.2a	59.3a	66.1a	71.5a

Means followed by the same letters are not statistically different at the 5% level of significance by DMRT. T_1: Control, T_2: Cowdung + Mustard oil cake (MOC), T_3: N+ P_2O_5+K_2O and T_4: Cowdung +MOC+ N+ P_2O_5+K_2O

Table 2: Yield components of potato influenced by different treatments

Treatment	Number of shoot/plant	Shoot length (cm)
T_1	3.0b	29.6b
T_2	3.7ab	31.2ab
T_3	4.2a	33.5a
T_4	4.7a	35.4a

Means followed by the same letters are not statistically different at the 5% level of significance by DMRT. T_1: Control, T_2: Cowdung + Mustard oil cake (MOC), T_3: N+ + P_2O_5+K_2O and T_4: Cowdung +MOC+ N+ + P_2O_5+K_2O

Table 3: Yield components of potato as influenced by different treatments

Trea-ment	Tuber No. /hill	Yield/plant of tuber (gm)	Tuber size grading by diameter (cm)	Tuber size grading by length (cm)
T_1	5.0c	190d	4.2b	6.3b
T_2	7.0b	285c	4.5ab	7.4ab
T_3	7.5ab	320b	5.0a	7.9a
T_4	8.0a	365a	5.4a	8.2a

Means followed by the same letters are not statistically different at the 5% level of significance by DMRT. T_1: Control, T_2: Cowdung + Mustard oil cake (MOC), T_3: N+ P_2O_5+K_2O and T_4: Cowdung +MOC+ N+ P_2O_5+K_2O

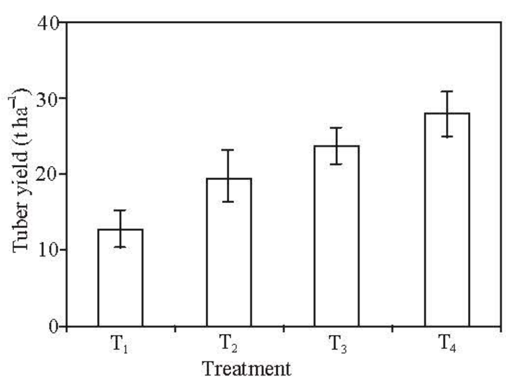

Fig. 1: Tuber yield of potato as affected by different combination of manure and fertilizers

+ 75kg K_2O t ha^{-1} shown highest tuber yield of 18.8 t ha^{-1} compared with 9.9 t ha^{-1} without NPK. It was 21.2 and 12.6 ton per ha with and without NPK in the present research work. Anonymous(1990) stated that 125kg N + 100 kg P_2O_5+ 120kg K_2O along with other organic fertilizer increased the tuber yield significantly.

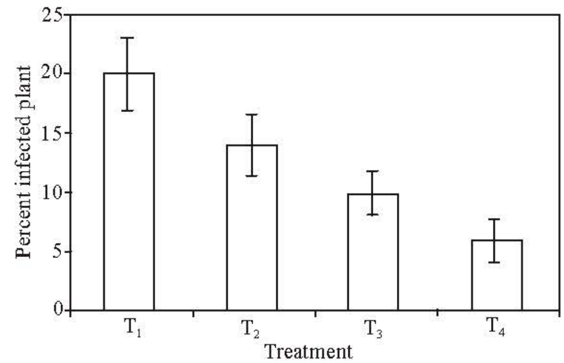

Fig. 2: Percent late blight of potato infected plant influenced by different combinations of manure and fertilizers

Miah *et al.* (1974) found that the combination of 180 kg N + 110 kg P_2O_5 + 75 kg K_2O per ha. Produced maximum grade tuber as well as the highest total yield as compared to without fertilizers. Rahman (1996) stated that maximum plant height, number of stem per plant, no. of tuber per hill and yield of tuber were 72.1cm, 4.15, 8.35, 22 t ha^{-1} respectively when potato was grown with cowdung +MOC +N +P_2O_5 + K_2O as compared to without fertilizers. Since potato is the most important vegetable crop in Bangladesh as well as other countries. Hence it may be recommended that potato should be grown following different combination of manures and fertilizers in order to get better yield and quality of potato tuber to consume as supplementary food of rice and wheat in exchange of cheapest cost and less labour for Bangladesh's people as well as other countries's people.

Acknowledgments

We are most grateful to Local Government Engineering Department, Ministry of LGRD for supporting in this work. We thank to Mrs. Maimuna Akter for her assistance in analyzing and computing data in this manuscript.

References

Ahmad, K.U., 1977. Potato for the tropics Banglow. No. 2 West of Agricultural Laboratory, Farmgate, Dhaka-15 Bangladesh, pp: 240.

Anonymous, 1990. Response of potato to NPK fertilizer. Bangladesh Agricultural Research Annual Report, 1989-90. B.A.RI. Joydebpur, Gazipur, Bangladesh, pp: 91.

Anonymous, 1991. Different types of food made by potato. Agricultural Information Service, Farmgate, Dhaka 15, Bangladesh, pp: 6.

BBS, 1996. Statistical year book of Bangladesh. Bangladesh Bureau of Statistics. Division Ministry of Planning. Govt. of Peoples Republic of Bangladesh, pp: 135-146.

FAO., 1995. FAO Production Yearbook 1994. Vol. 48, (FAO Statistics Series No. 125). Food and Agriculture Organization of the United Nations, Rome Italy, pp: 89-90.

Islam, M.S., S. Razia and K.M. Hossain, 1982. Effect of different fertilizer elements on the growth and yield of potato. Bangla. J. Agric., 7: 56-63.

Madhikarmy, S.G., 1978-79. Effect of NPK fertilizer on the performance of Kufijoyti potato in Nepal. J. Agric., B/14 : 125-131.

Miah, A.M., A. Hossain and M.A. Siddique, 1974. Effect of nitrogen Phosphorus and Potash at different levels on the size and yield of potato. Bangla. Horti., 2: 17-23.

Rahman, L., 1996. Effect of Mulch different manures and fertilizers M.S Thesis. Department of Horticulture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

Rashid, M.M., 1993. Potato cultivation. Shabjibijan. 1st Edition. Bangla Academy, Dhaka Bangladesh, pp: 450-455.

Sengupta, P.C. and A.G. Karmakar, 1986. Response of potato to different level of Nitrogen Phosphorus and Potash. Environmental Ecol., 4: 663-666.

Shah, M.A. and M. Ismail, 1983. The Effect of different level of NPK on potato yield J. India Potato. 10: 136-139.

Sharfuddin, A.F.M. and M.A. Siddique, 1985. Production of different vegetable in Bangladesh. Shabjibijan 1st edition. Mohammodia Press, Mymensingh, Bangladesh, pp: 58.

Siddique, M.A. and M.M. Rahsid, 1990. Scope of increasing Indigenous variety of Bangladesh. B.A.D.C. Dhaka, Bangladesh, pp: 166-167.

Thompson, H.C. and W.C. Kelly, 1957. Vegetable crop, 5th Edition Mc Graw. Hill Book Co. New York, pp: 372-404.