

Technology Section

Pak. j. sci. ind. res., vol. 34, nos. 2-3, February-March 1991

EFFECT OF IRRIGATION AND FERTILIZER PLACEMENT ON THE GROWTH AND YIELD OF POTATO

M. AKHTER HOSSAIN CHOWDHURY AND A.K.M. SAYEDUL HAQUE CHOWDHURY

Bangladesh Agricultural University, Mymensingh, Bangladesh

(Received May 16, 1989; revised November 14, 1990)

A study was conducted with four frequencies of irrigation 0,1,2,3 and 4 methods of fertilizer placement - broadcast, single band, double band and plough sole with a view to finding out the optimum number of irrigation and proper method of fertilizer placement for Baraka variety of potato. Results revealed that potato might be grown under residual soil moisture conditions. Single and double band placement methods were found superior to broadcast and plough sole methods in producing tuber yield/ha.

Key words : Irrigation, Fertilizer, Potato.

Introduction

The dependence of high tuber yields upon an adequate supply of soil water is well known and can be illustrated by the good correlation often shown between rainfall and yield. The increase in yield of 1.4t/ha for each cm of rainfall is similar to yield responses found in irrigation experiments in Britain [1]. He also pointed out that water requirement of Potato plant at different stages of its growth is different. The most sensitive phases are the stolonization and beginning of tuberization. At these stages the water requirement is greatest [2]. Sufficient soil moisture is therefore necessary at tuber bulking stage for proper development of tubers [3]. Water deficiency below certain limit results in poor emergence, serious reduction in yield and deterioration of tuber quality. Yield was reported to be linearly related to soil moisture deficit for every centimeter increase in soil moisture deficit 3.3t/ha fresh tubers and 0.8t/ha of tuber dry matter were lost [4]. Thus proper timing and frequency of irrigation under different locations need to be determined. The importance of application of mineral nutrition particularly N, P, K and their proper placement in Potato plants is well documented.

Potato is a heavy feeder demanding large quantities of fertilizers. One hectare of potato may absorb 4.3 kg N, 0.7 kg P_2O_5 , 7.2 kg K_2O , 1.8 kg CaO, 1.1 kg MgO, and 0.3 kg S during peak rate of absorption per day and the tuber yields may increase 1130- 1700 kg/ha/day during the periods of rapid growth [5]. In Bangladesh, three of those nutrients N,P and K are generally supplemented by adopting different methods of their placement in the crop field. It has been shown that the form of the yield response to fertilizer can be altered by the method of placement [1].

A study was therefore, undertaken to see the effect of irrigation and fertilizer placement on the growth and yield of potato.

Materials and Methods

The experiment was carried out in garden at Bangladesh Agricultural University, Mymensingh during the period from December, 1986 to March, 1987. The soil of the experiment site was sandy loam with pH 6.5, nitrogen 0.086%, phosphorus 10 ppm, Potash 0.22 me/100g, Sulphur 17 ppm and organic carbon 1.20%.

The experimental treatments were as follows:

1. Frequency of irrigation.

- (a) 0 Irrigation — No irrigation was done, crop was grown under residual soil moisture.
- (b) 1 Irrigation — Irrigation was done at tuber bulking.
- (c) 2 Irrigation — Irrigations were done at tuber initiation and tuber bulking.
- (d) 3 Irrigation — Irrigations were done at stolon initiation, tuber initiation and tuber bulking.

2. Method of fertilizer placement.

- (a) Broadcast — Fertilizers were broadcast at the final preparation of land.
- (b) Single band — Fertilizers were applied in furrow by one side of row, 20 cm apart from the row, at the time of planting.
- (c) Double band — Fertilizers were applied as in (b) but by both sides of the row.
- (d) Plough sole — Fertilizers were placed at the bottom of the furrow and mixed with soil before planting the seed on it.

The experiment was laid out in split-plot design by placing frequency of irrigation in the main plot and method of placement of fertilizer in the split plot. Three replications were used in the experiment. The size of unit plot was 5m x 4m. Seed

tubers of Baraka variety, obtained from Netherlands through Bangladesh Agricultural Research Council were used in the experiment.

The experimental land was prepared well and fertilized with N,P and K at the rate of 90, 45 and 185 kg/ha supplied through urea, triple super phosphate and muriate of potash, respectively, as per experimental treatments [6]. Seeds were planted on December 3, 1986 in furrow giving 65 cm x 30 spacing. After planting ridges were made along the rows. Irrigation was done as per experimental treatments as already stated. All other Intercultural operations like weeding and ridging were done uniformly in all the plots. The crop was harvested on March 16, 1987.

Data were collected in respect of emergence (at five day intervals after one month of planting), plant height, number of shoot/hill, number and weight of tuber/hill and tuber yield/ha (cald. from yield/plot). The collected data were analysed statistically following the Duncan's New Multiple Range Test.

Results and Discussion

The results of the experiment have been presented in Tables 1-3. The emergence of shoot from seed tubers was affected significantly by the methods of fertilizer placement in the soil (Table 1). Generally the rate of tuber growth affected due to nutrient deficiency [1,7]. A percentage emergence of first shoot was statistically similar in broadcast, single band and double band treated plots. Emergence was significantly lower in case of plough sole placement method than in other methods. The emergence was uniform for the broadcast, single band and double band methods, whereas the emergence was very slow in plough sole possibly due to the inhibitory effects of ammonia generated from urea due to volatilization just beneath the seed tubers. Therefore, 16% seed tubers were unable to produce shoots.

Frequency of irrigation had significant effects on plant height, shoot number, tuber number and tuber yield/ha. Tuber weight was unaffected by irrigation (Table 2). Irrigation irrespective of frequencies produced significantly taller plants with less number of shoot and tuber/hill indicating that irrigation depressed the production of shoot and tuber under the prevailing conditions of experiment. The water table was high in the experimental area. The soil had sufficient moisture during each irrigation (about 70% of the field capacity). Application of water in the soil retained in the soil at saturated conditions for few days. This condition might not be favourable for the growth of underground parts, as a result lower number of shoot and tuber was obtained in irrigated plots irrespective of number of irrigations. The growth as expressed by the aforesaid characters was reflected in yield. Tuber yield was significantly depressed in 1 and 3 times irrigated crops. The

intensity of depression was highest with 3 irrigations. Irrigation exerted no significant effect on potato yield in the same experimental site [8].

From Table 3 it is distinctly clear that placement of fertilizers did not exert any significant effect on the plant height, shoot and tuber number/hill. Maximum yield of potato was found in single and double band plots followed by broadcast and plough sole plots. Minimum yield of potato from broadcast and plough sole plots was due to decreasing of tuber weight per hill.

The most efficient placement of fertilizer is very important for an adequate supply of soluble nutrients to the potato plant. The efficiency of fertilizer use is partly determined by the ultimate position of the fertilizer in the ridge, which can make differences in potato yield [9]. In this present study maximum yield of potato was found in single and double band plots and followed by broadcast and plough sole plots was due to decreasing of tuber weight per hill (Table 3). The placement

TABLE 1. EFFECT OF PLACEMENT OF FERTILIZERS ON THE EMERGENCE OF SHOOT FROM SEED TUBERS.

Placement of fertilizer	Percent emergence					
	Days after planting					
	30	35	40	45	50	55
Broadcast	96a	98a	99a	99a	99a	99a*
Single band	92a	92a	99a	100a	100a	100a
Double band	93a	99a	100a	100a	100a	100a
Plough band	44b	61b	80b	84b	84b	84b

Emergence started after 17 days of planting.

*Figures followed by common letter do not differ significantly and those followed by dissimilar letter(s) differed significantly at 1% level.

TABLE 2. EFFECT OF FREQUENCY OF IRRIGATION ON THE GROWTH AND YIELD OF POTATO.

Frequency of irrigation	Plant height (cm)	Shoot/hill (Number)	Tuber/hill		Tuber yield (kg/ha)
			Number	weight (gm)	
0	54.06b	2.92a	7.12a	454a	15274a
1	60.87a	2.14b	4.75b	456a	14585b
2	59.45a	2.23b	4.86b	437a	15092a
3	60.60a	2.30b	4.29b	449a	13088c

Figures followed by common letter do not differ significantly and those followed by dissimilar letter (s) differ significantly at 1% level.

TABLE 3. EFFECT OF PLACEMENT OF FERTILIZERS ON THE GROWTH AND YIELD OF POTATO.

Fertilizer placement	Plant height (cm)	Shoot/hill (Number)	Tuber/hill		Tuber yield (kg/ha)
			Number	weight (gm)	
Broadcast	59.65a	2.52a	5.24a	394b	12725b
Single band	56.53a	2.29a	5.53a	551a	16491a
Double band	60.20a	2.20a	5.84a	589a	17006a
Plough sole	58.17a	2.47a	5.45a	332c	11758c

Figures followed by common letter do not differ significantly and those followed by dissimilar letter (s) differ significantly at 1% level.

of fertilizer at some depth below the seed tuber has been shown to be beneficial [10]. In plough sole placement plots emergence was lowest i.e. the plant stand was less than in all other treatments as has already been stated. In broadcast method, non-availability of some supplemented nutrients by the roots of the plants might be the cause of low weight of tuber and or the inhibitory effects of ammonia from urea might be another factor for depressing tuber weight/hill. On the other hand it is distinctly clear that placement of fertilizers did not exert any significant effect on the plant height, shoot and tuber number/hill.

In fine, under the conditions of Bangladesh Agricultural University Farm, potato may be grown successfully under residual soil moisture conditions. Single or double band placement of fertilizers may be suggested for raising potato crop.

References

1. P.M. Harris, *Mineral Nutrition, In. The Potato Crop* (Chapman and Hall, 1978), pp, 1-730.
2. B.R. Delis, I. Fence and R. Tizio, *Agron. J.*, **56** (4), 377 (1964).
3. O. Steiweek, *Dtsch. Bands Pr.*, **81** (19), 189 (1958).
4. R.M. Hagan, Y. Vaadia and M.B. Russell, *Advances in Agronomy* (1978), Vol. II, pp.77-98 (reference 1).
5. M.S. Islam, *Fertilizing Potato for High Yield. Proc., 3rd Workshop of Potato Research Workers*, July 16-17, (1980), *Potato Res. Cen. Bangladesh Agric. Res. Inst. Joydebpur, Dhaka*, pp. 55 (1980).
6. M.M. Rashid, *Effect of N.P.K. on Potato Yield, Proc. 5th Workshop of Potato Research Works*, July 25-26 1986, *Bangladesh Agric. Res. Inst. Joydebpur, Dhaka*, pp. 45 (1986).
7. H.P.M. Gunaseng and P.M. Harris, *J. Agric. Sci. Camb.*, **73**, 245, (1978).
8. M. Shamsuddin, *Effect of Irrigation on the Yield of four Local Cultivars of Potato, A Thesis Submitted to Faculty of Agriculture, Bangladesh Agriculture University, Mymensingh*, pp. 49 (1978).
9. T. Batey and D.A. Boyd, *NAAS, Quart. Rev.*, **78**, 47, (1967).
10. R. Holliday and A.P. Drycott, *J. Agric. Sci. Camb.*, **71**, 413 (1968).