Journal of Crop and Weed 8(1): 145-148 (2012)

Effect of organic and inorganic sources of nutrients on potato [*Solanum tuberosum* L.] production and soil fertility build-up

W. P. DEVI AND [1]A. ZAMAN

Subject Matter Specialist (Agronomy),
KVK, Upper Subansiri, Arunachal Pradesh - 791122
[1]Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal

Received: 31.01.2011, Revised: 25.12.2011, Accepted : 25.04.2012

Key words: Fertilizers, organic manures, yield

Among the food crops known to mankind, potato is the fourth most important productive and nutritious food crop and comes next only to rice, wheat and maize. Because of its high protein-calorie ratio (17 g protein: 1000 Kcal) and short vegetative cycle, potato yields more substantially edible energy, protein and dry matter per unit area and time than many other crop species. It allows the farmers to harvest up to 80 % of dry matter as edible nutritious food, as compared to only 50 % of the cereals as grain (Pandey and Sarkar, 2005). In the world, India with 25 million tons produce comes in the third position in potato production next to China (75 million tons) and Russia (37 million tons) (Chaturvedi, 2007). Despite this, productivity of potato in India is quiet low as compared to that of European countries like USA, UK, Belgium, New Zealand and the Netherlands where the value ranges between 300-450 q ha^{-1} (Chadha, 2001). More than 80 % of the potato crop is raised in the Gangetic plains in the winter season during October to March. West Bengal contributes 26 % of the total potato production in India and comes next only to Uttar Pradesh with 32 % (Babu, 2008). Potato is a highly input intensive crop. Fertilization with inorganic sources of nutrients plays an important role for its higher production. But due to increased cost of inorganic fertilizers and their detrimental effects on soil fertility and human health, supplementing the nutrients through organic sources has become necessary to sustain production and improve or maintain soil health. Keeping these points in view, the present experiment was carried out to select suitable variety and organic sources for higher potato product on a suitable basis.

The present experiment was conducted at the Block Seed Farm, Adisaptagram, Hoogly, West Bengal during *rabi* season of 2006-07 and 2007-08. The experiment was laid out in split-plot design, three potato varieties (Kufri Chipsona-1, Kufri Chipsona-2 and Kufri Jyoti) were allocated to the main plots and four different sources of nutrients FYM @ 35 t ha^{-1}, FYM @ 30 t ha^{-1} + biofertilizers (*Azotobacter* and *Phosphobacteria*), FYM @ 25 t ha^{-1} + mustard cake @ 10 q ha^{-1}, recommended dose of NPK @ 180 kg N: 150 kg P_2O_5: 150 kg K_2O ha^{-1} to the sub-plots. The soil of the experiment field was sandy loam having pH 6.2, organic carbon 0.83 %, available nitrogen 300.27 kg, available phosphorous 12.85 kg and available potassium 218.5 kg ha^{-1}. The crop growth rate (CGR) and tuber bulking rate (TBR) were calculated by using following formulae

$$CGR = \frac{W_2 - W_1}{T_2 - t_1}$$

Where, W_1 and W_2 are dry weights of plant parts per unit area at two different times t_1 and t_2, respectively

$$TBR = \frac{M_2 - M_1}{T_2 - t_1}$$

Where, M_1 and M_2 are dry weights of tubers per unit area at different times t_1 and t_2, respectively.

The harvested tubers were graded into four different grades (< 25 g, 26-50 g, 51-75 g and > 75 g) according to their sizes. These were counted and weighed separately.

The pooled data in table- 1 revealed that Kufri Chipsona-1 recorded the maximum number of stems (3.97), number of leaves per plant (120.56), dry matter accumulation, CGR and TBR at different stages of observation. The maximum total number of tubers per hectare (675.02 thousand ha^{-1}) as well as total yield (28.28 t ha^{-1}) was recorded in Kufri Chipsona-1(Table-4). The results are in agreement with the findings of Kumar *et al.* (2005) and Pandey *et al.* (2005) respectively. Maximum build-up of soil fertility after harvest of crop (350.25 kg ha^{-1} N, 21.45 kg ha^{-1} P_2O_5 and 239.86 kg ha^{-1} K_2O) was also recorded in Kufri Chipsona-1 (Table 5). Kufri Chipsona-2 recorded tallest height (75.01 cm) at harvest and maximum number of < 25 g tubers (191.28 thousands ha^{-1}) but Kufri Jyoti gave the highest yield (6.85 t ha^{-1}) of < 25 g tubers (Table 3).

Application of recommended dose of NPK @ 180 kg N: 150 kg P_2O_5: 150 kg K_2O ha^{-1} showed the maximum height (76.76 cm) at harvest, number of leaves (122.70), dry matter accumulation, CGR and TBR at all stages of observation (Table 1). Ultimately, this treatment also produced the maximum total number of tubers (604.89 thousands ha^{-1}) and total tuber yield (27.60 t ha^{-1}). It was also observed that yield of large and very large sized tubers were highest in plants receiving recommended

Short communication

Email: wpuina@yahoo.co.in

dose of NPK indicating that increase in yield was due to increases in size of tubers (Table 3). The results also confirmed the findings of Upadhyay *et al.* (2003) who reported the importance of organic farming in production of seed size tubers (< 50 g). Maximum soil fertility build-up (353.75, 21.73 and 240.03 kg ha^{-1} available N, P_2O_5, and K_2O, respectively) was observed where FYM @ 30 t ha^{-1} along with biofertilizers were applied (Table 5). These observations are in agreement with the findings of Kumar *et al.* (2007). This may be due to the availability of micro-organisms to fix atmospheric nitrogen and increase its availability to the growing plants.

Table 1: Effect of varieties and nutrients on growth parameters of potato (pooled)

Treatments	No. of stems	No. of leaves	Total dry matter accumulation ($g\ m^{-2}$)			CGR ($g\ m^{-2}day^{-1}$)		TBR ($g\ m^{-2}day^{-1}$)	
			60 DAP	75 DAP	90 DAP	60 – 75 DAP	75 – 90 DAP	60 – 75 DAP	75 – 90 DAP
Variety									
V_1	3.97	120.56	455.25	695.14	889.39	16.00	12.96	15.35	13.03
V_2	3.52	92.04	412.76	623.75	771.03	14.07	9.82	12.76	9.35
V_3	3.33	86.60	377.17	598.19	759.95	14.74	10.78	13.17	9.75
SEm (±)	**0.04**	**0.31**	**0.78**	**0.94**	**1.09**	**0.01**	**0.01**	**0.07**	**0.03**
LDS (0.05)	**0.11**	**1.00**	**2.56**	**3.05**	**3.54**	**0.05**	**0.07**	**0.23**	**0.08**
Nutrient									
N_1	3.30	91.54	414.49	638.11	805.04	14.91	11.13	13.71	10.69
N_2	3.61	98.51	417.88	642.50	810.85	14.96	11.22	13.80	10.76
N_3	3.19	86.17	400.27	622.25	787.77	14.80	11.04	13.59	10.55
N_4	4.32	122.70	427.62	653.24	823.49	15.04	11.36	13.94	10.84
SEm (±)	**0.04**	**0.32**	**0.89**	**0.98**	**1.03**	**0.02**	**0.01**	**0.06**	**0.02**
LDS (0.05)	**0.12**	**0.93**	**2.54**	**2.81**	**2.95**	**0.07**	**0.04**	**0.16**	**0.07**

Table 2: Interaction effect of varieties and nutrients on growth parameters of potato (pooled)

Treatment combinations	Plant height (cm)	No. of stems	No. of leaves	Total dry matter accumulation ($g\ m^{-2}$)			CGR ($g\ m^{-2}day^{-1}$)		TBR ($g\ m^{-2}day^{-1}$)	
				60 DAP	75 DAP	90 DAP	60 – 75 DAP	75 – 90 DAP	60 – 75 DAP	75 – 90 DAP
V_1N_1	66.50	3.58	112.60	452.45	692.00	885.42	15.97	12.90	15.29	13.04
V_1N_2	67.23	4.07	123.20	457.12	698.07	893.00	16.00	13.00	15.45	13.10
V_1N_3	63.88	3.47	105.37	443.08	680.73	872.58	15.84	12.79	15.13	12.80
V_1N_4	72.32	4.75	141.07	468.38	709.78	906.58	16.09	13.15	15.53	13.18
V_2N_1	72.68	3.35	87.17	413.31	623.96	770.29	14.04	9.76	12.72	9.31
V_2N_2	74.85	3.53	91.13	414.63	626.06	774.29	14.10	9.87	12.78	9.38
V_2N_3	70.88	3.20	80.05	397.90	607.00	752.20	13.94	9.68	12.60	9.24
V_2N_4	81.62	3.98	109.80	425.21	637.96	787.59	14.18	9.98	12.95	9.47
V_3N_1	66.23	2.97	74.85	377.70	598.37	759.40	14.71	10.74	13.13	9.72
V_3N_2	68.23	3.22	81.20	381.91	603.38	765.53	14.77	10.81	13.18	9.79
V_3N_3	64.13	2.90	73.10	359.83	579.03	738.55	14.61	10.64	13.04	9.63
V_3N_4	76.33	4.22	117.23	389.27	611.99	776.32	14.85	10.96	13.33	9.88
SEm (±)*	**0.53**	**0.07**	**0.56**	**1.56**	**1.70**	**1.78**	**0.04**	**0.02**	**0.10**	**0.04**
LSD (0.05)*	**1.53**	**0.20**	**1.61**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 3: Effect of varieties and nutrients on number and yield of tubers (pooled)

Treatments	Number of tubers (thousand ha^{-1})				Total	Yield of tubers (t ha^{-1})				Total
	< 25 g	26 – 50 g	51 – 75 g	> 75 g		< 25 g	26 – 50 g	51 – 75 g	> 75 g	
Variety										
V_1	169.64	248.63	144.36	112.09	675.02	5.76	6.66	8.65	7.21	28.28
V_2	191.28	236.56	96.89	58.63	583.27	6.78	5.88	5.83	5.19	23.82
V_3	171.22	203.63	98.41	51.13	524.41	6.85	7.03	6.84	5.90	26.63
SEm (±)	**0.42**	**0.27**	**0.24**	**0.25**	**0.22**	**0.20**	**0.26**	**0.27**	**0.54**	**0.19**
LSD (0.05)	**1.38**	**0.88**	**0.77**	**0.82**	**0.73**	**0.64**	**0.86**	**0.90**	**1.75**	**0.61**
Nutrient										
N_1	178.35	230.70	110.16	71.51	590.76	6.38	6.33	7.07	6.03	25.81
N_2	180.44	227.70	112.73	73.20	594.12	6.45	6.51	7.17	6.17	26.30
N_3	183.60	239.58	98.49	65.52	587.16	6.13	6.25	6.96	5.94	25.27
N_4	167.12	220.43	131.50	85.57	604.89	6.90	7.02	7.24	6.26	27.60
SEm (±)	**0.37**	**0.32**	**0.27**	**0.25**	**0.34**	**0.35**	**0.29**	**0.28**	**0.65**	**0.31**
LSD (0.05)	**1.06**	**0.91**	**0.79**	**0.72**	**0.97**	**1.00**	**0.08**	**0.79**	**1.86**	**0.90**

Table 4: Interaction effect of varieties and nutrients on number and yield of tubers (pooled)

Treatment combinations	Number of tubers (thousand ha^{-1})				Total	Yield of tubers (t ha^{-1})				Total
	< 25 g	26 – 50 g	51 – 75 g	> 75 g		< 25 g	26 – 50 g	51 – 75 g	> 75 g	
V_1N_1	171.47	249.21	140.47	110.36	671.50	5.74	6.29	8.52	7.22	27.77
V_1N_2	170.38	248.70	144.08	111.95	675.11	5.71	6.52	8.87	7.23	28.34
V_1N_3	174.54	254.71	134.92	103.83	668.00	5.50	6.28	8.52	7.07	27.37
V_1N_4	162.17	241.88	157.96	122.24	685.48	6.10	7.56	8.71	7.30	29.67
V_2N_1	191.13	236.29	94.58	57.57	579.56	6.50	5.80	5.93	5.10	23.34
V_2N_2	194.66	236.54	92.87	59.46	583.64	6.79	5.96	5.81	5.23	23.80
V_2N_3	197.28	238.09	89.90	50.86	576.10	6.34	5.60	5.66	5.06	22.66
V_2N_4	182.06	235.34	110.19	66.61	593.78	7.48	6.14	5.91	5.38	25.47
V_3N_1	172.46	206.61	95.42	46.60	521.22	6.91	6.89	6.75	5.76	26.31
V_3N_2	176.29	197.88	101.23	48.20	523.62	6.85	7.04	6.82	6.05	26.76
V_3N_3	178.97	225.93	70.65	41.88	517.39	6.53	6.86	6.71	5.70	25.79
V_3N_4	157.15	184.08	126.35	67.87	535.42	7.11	7.35	7.10	6.09	27.65
SEm (±)*	**0.64**	**0.55**	**0.48**	**0.43**	**0.59**	**0.60**	**0.51**	**0.48**	**1.12**	**0.54**
LSD (0.05)*	**1.84**	**1.58**	**1.36**	**1.24**	**NS**	**1.73**	**1.46**	**1.38**	**NS**	**1.56**

Table 5: Effect of varieties and nutrients on soil available NPK (kg ha^{-1}) after cropping (pooled)

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Variety			
V_1	350.25	21.45	239.86
V_2	349.85	21.27	238.14
V_3	350.07	21.50	239.33
SEm (±)	**0.32**	**0.17**	**0.31**
LSD (0.05)	**NS**	**NS**	**NS**
Nutrient			
N_1	345.60	20.03	237.07
N_2	363.63	24.46	246.53
N_3	337.24	19.40	232.75
N_4	353.75	21.73	240.03
SEm (±)	**0.42**	**0.35**	**0.34**
LSD (0.05)	**1.21**	**1.01**	**0.98**

Table 6: Interaction effect of varieties and nutrients on soil available NPK (kg ha^{-1}) after cropping (pooled)

Treatment combinations	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
V_1N_1	346.41	20.33	237.62
V_1N_2	362.76	24.14	247.28
V_1N_3	336.61	19.53	233.69
V_1N_4	355.24	21.81	240.85
V_2N_1	345.68	19.99	236.45
V_2N_2	363.98	24.45	245.21
V_2N_3	336.91	19.28	231.58
V_2N_4	352.85	21.35	239.35
V_3N_1	344.73	19.79	237.13
V_3N_2	364.17	24.78	247.10
V_3N_3	338.22	19.40	233.00
V_3N_4	353.16	22.03	240.08
SEm (±)*	**0.73**	**0.61**	**0.59**
LSD (0.05)*	**NS**	**NS**	**NS**

Variety Kufri Chipsona-1 when supplied with recommended dose of NPK recorded the maximum number of stems (4.75), number of leaves per plant (141.07), dry matter accumulation, CGR and TBR at all stages of observation (Table 2). Sarkar *et al.* (2007) also found similar results. This treatment combination also showed the maximum total number of total tubers (685.48 thousands ha^{-1}) and total tuber yield (29.67 t ha^{-1}). Regarding soil fertility build-up, interaction of variety and nutrients did not show any significant result. However, maximum soil available N and P (364.17 kg ha^{-1} and 24.78 kg ha^{-1}), respectively were observed in Kufri Jyoti and maximum soil available K (247.28 kg ha^{-1}) in Kufri Chipsons-1 when treated with FYM @ 30 t ha^{-1} along with bio-fertilizers (Table 6). These results are in accordance with findings of Kumar and Lal (2003).

The above results confirmed the importance of fertilizers for increasing production in potato crop. However, supplementing plant nutrients through organic sources like FYM and biofertilizers may be recommended to potato farmers to promote potato production on an eco-friendly manner. It may also be concluded that organic farming may be followed as a promising technique to produce more seed size tubers and solve the problem of lack of potato seed tubers.

REFERENCES

Babu, G.R.P. 2008. Potato: Food for the World's Poor. *Science Reporter*, June, pp. 38-41.

Chadha, K.L. 2001. Sustaining potato revolution in India: Constraints and strategies. *J. Indian Potato Assoc.*, **28**:195-200.

Chaturvedi, R. 2007. Contract farming and fritolay's model of contract farming for potato. *Potato J.*, **34**: 16-19.

Kumar, D. and Lal, S.S. 2003. Evaluation of mustard cake in combination with fertilizers for potato production in Bihar. *J. Indian Potato Assoc.*, **30**: 75-76.

Kumar, M., Sah, U., Gupta, V. K., Pandey, N. K., Deha, C. K. and Baishya, L. K. 2005. On-farm assessment of application of bio-fertilizers in potato production in east Khasi hill district of Meghalaya. *Potato J.*, **32**: 227-28.

Kumar, P., Pandey, S.K., Singh, B.P., Singh, S.V. and Kumar, D. 2007. Optimising phosphorous requirement of Chipsona varieties for West-Central plains of India. *Potato J.*, **34**: 199-02.

Pandey, S. K. and Sarkar, D. 2005. Potato in India: Emerging trends and challenges in the new millennium. *Potato J.*, **32**: 93-04.

Pandey, S. K., Khurana, S. M. P., Singh, S.V., Kumar, D. and Kumar, P. 2005. Evaluation of Indian and exotic potato varieties for sustaining processing in North-western plains of India. *Indian J. Hort.*, **62**: 155-59.

Sarkar, B., Mondal, S. S., Nayek, S. S., Saha, M. and Biswas. S. 2007. Integrated nutrient management for the productivity and quality improvement of potato under irrigated condition. *Potato J.*, **34**: 99-100.

Upadhayay, N.C. and Singh, J.P. 2003. Organic farming. *In: The Potato Production and Utilization in Sub-tropics* (Eds. Khurana, S.M.P., Minhas, J.S. and Pandey, S.K.), Mehta Publishers, New Delhi, India, pp. 154-60.