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The effect of organic sources of nutrients on the growth attributes and yields of potato (*Solanum tuberosum L.*)

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ABSTRACT

A field experiment was conducted for two consecutive years to study the growth and yield of potato during rabi season under different sources of organic nutrients. Application of vermicompost @ 8 t ha^{-1} + biofertilizers in potato (cv.Kufri Jyoti) gave better effect in terms of growth, yield as well as the biochemical parameters. There was significant increase in yield by the application of vermicompost @ 8 t ha^{-1} + biofertilizers (20.59 t ha^{-1}) over control (7.37 t ha^{-1}). Application of vermicompost @ 8 t ha^{-1} + biofertilizers showed positive effect on crop growth rate and tuber bulking rate of the crop.

Key words: Biofertilizers, crop residues, potato, vermicompost

Potato requires high amount of nutrient and ever since the beginning of the Green Revolution the nutrient requirement of this crop is mainly supplied through synthetic fertilizers. With the passage of time, as extensive dependence on chemical farming has shown to be detrimental for soil health and sustainability. Gradual loss of soil fertility and also productivity are demanding larger quantities of fertilizers to be used. Thiscalls for establishing alternative solution to overcome the ill-effects of chemicals in all aspects such as soil health and environment, and this can be achieved partly through the use of organic nutrients in potato production. Some past work may be referred to justify your work.

MATERIALS AND METHODS

A field experiment was conducted during the rabi season of two consecutive years 2007-08 and 2008-09 at Gangetic alluvium soil of Block Seed Farm, Adisaptagram, Hooghly, West Bengal on potato with the main objective to study the effects of organic sources of nutrients on the growth and yield of potato. The experimental site is located at approximately 22.57^{0}N latitude and 88.20^{0}E longitude at an elevation of 7.8 m above mean sea level and the ecosystem is medium land. The experimental soil was sandy-loam in texture with pH of 6.6, organic carbon 0.85%, total N 150.30 kg ha^{-1}, available P_2O_5 25.29 kg ha $^{-1}$ and available K_2O 110.31 kg ha $^{-1}$. The experiment was conducted in Randomized Block Design with three replications. There were 8 treatments *viz*, T_1: control (no nutrient inputs) , T_2: crop residue@ 8 t ha^{-1}, T_3 : crop residue @ 5 t ha^{-1} + biofertilizers, T_4 : FYM @ 30 t ha^{-1}, T_5 : crop residue @ 5 t ha^{-1} + FYM @ 20 t ha^{-1}, T_6 : vermicompost @ 10 t ha^{-1}, T_7: vermicompost @ 5 t ha^{-1}, T_8 : vermicompost @ 8 t ha^{-1}+ biofertilizers. Potato variety *Kufri Jyoti* (resistant to potato viruses) was planted at rate of 25 q ha^{-1} with spacing of 60 cm× 20 cm. All recommended cultural practices were followed to raise a healthy crop. Rapid titrimetric method (Moorthy and Padjama, 1996) and 2, 6-dichlorophenol endophenyl dye titration method (Anon, 1984) was followed for estimation of starch and ascorbic acid content respectively. The statistical analysis of the recorded data was done by analysis of variance method (Gomez and Gomez, 1984). The significance of different sources of variations was tested by Error Mean Square by Fisher and Snedecor's 'F'-test at probability level of 0.05. For the determination of least significant difference at 5% level of significance Fisher's and Yates tables were consulted.

RESULTS AND DISCUSSION

Effect of organic nutrients on fresh weight and dry weight of tuber

From table-1, it is observed that at 50 DAP, treatment T_8 (vermicompost @ 8t ha^{-1} + biofertilizers) recorded the maximum fresh weight of tuber (636.30g m^{-2}) followed by treatment T_6 (vermicompost @10 t ha^{-1}) with a value of (621.41 g m^{-2}). At 65 DAP, the maximum (902.80 gm^{-2}) is again recorded by T_8 (vermicompost @8t ha^{-1} + biofertilizers). Similar trends were observed in the next observation at 80 DAP and 95 DAP. Dry weight of tubers differed significantly with different treatments and at different growth stages (Table 1). At 80 DAP, the maximum tuber dry weight (383.07g m^{-2}) was obtained in T_8 followed by T_6. The same trend was followed at 95 DAP.

Effect of organic nutrients on crop growth rate (g m^{-2}d^{-1})

It is seen that during 50-65 DAP, the maximum CGR (5.65 g m^{-2}d^{-1}) was recorded (Table 2) by T_8-vermicompost @ 8t ha^{-1} + biofertilizers which was statistically at par with the treatments T_5 - crop residue @ 5t ha^{-1}+ FYM @ 20t ha^{-1} (5.45g m^{-2} d^{-1}), T_3- crop residue @ 5t ha^{-1}+ biofertilizers (5.30g m^{-2}d^{-1}), and T_6 -vermicompost @ 10 t ha^{-1} (4.96 gm^{-2}d^{-1}). At 65-80 DAP, the highest CGR is again recorded by vermicompost @ 8 t ha^{-1} + biofertilizers (9.93 g m^{-2}d^{-1}). As the crop reached to maturity stage, the CGR gradually slowed down and during the period of 80-95 DAP, the maximum value was still obtained in T_8.

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Table 1: Effect of different nutrients on growth attributes of potato (pooled data)

Treatments	Fresh weight of tubers (g m^{-2})				Dry weight of tubers (g m^{-2})			
	50 DAP	65 DAP	80 DAP	95 DAP	50 DAP	65 DAP	80 DAP	95 DAP
T_1	411.13	437.38	602.80	662.88	38.54	82.45	224.22	333.59
T_2	439.16	510.20	647.22	921.65	42.83	93.02	246.53	352.24
T_3	619.84	836.01	973.25	1003.41	48.85	175.31	355.28	472.60
T_4	577.38	751.52	927.45	1022.16	46.32	166.13	337.61	458.52
T_5	618.22	848.36	955.50	1037.29	47.74	165.76	344.88	451.96
T_6	621.41	868.33	1003.01	1036.70	47.64	182.58	381.44	491.77
T_7	584.09	783.18	968.04	1010.31	45.51	156.74	323.61	439.11
T_8	636.30	902.80	1022.26	1044.19	50.39	183.17	383.07	502.75
SEm(±)	**3.10**	**0.74**	**1.49**	**1.85**	**0.98**	**3.56**	**1.11**	**1.71**
LSD(0.05)	**9.41**	**2.25**	**4.54**	**5.61**	**2.48**	**10.81**	**3.38**	**5.19**

Table 2: Effect of differentnutrients on crop growth rate and tuber bulking rate of potato (pooled data)

Treatments	Crop growth rate (g $m^{-2}d^{-1}$)			Tuber bulking rate (g $m^{-2}d^{-1}$)		
	50-65DAP	65-80DAP	80-95DAP	50-65DAP	65-80DAP	80-95DAP
T_1	1.50	3.93	0.85	3.04	8.90	7.28
T_2	3.20	5.77	1.91	3.67	9.95	7.94
T_3	5.30	8.80	2.60	9.30	12.92	8.39
T_4	4.31	7.89	2.19	8.26	12.07	8.05
T_5	5.45	8.14	2.44	9.58	12.37	8.24
T_6	4.96	7.79	2.56	8.93	13.27	8.51
T_7	4.26	6.53	2.10	5.05	11.90	7.99
T_8	5.65	9.93	3.23	10.91	14.26	8.90
SEm(±)	**0.33**	**0.72**	**0.38**	**0.64**	**0.46**	**0.14**
LSD(0.05)	**1.02**	**2.19**	**1.15**	**1.96**	**1.41**	**0.44**

Table 3: Effect of differentnutrients on yield, ascorbic acid and starch content of potato (pooled data)

Treatments	Yield (t ha^{-1})	Biochemical parameters	
		Ascorbic acid (mg 100 g^{-1})	Starch (mg 100 g^{-1})
T_1	7.37	7.14	122.12
T_2	12.77	8.67	129.43
T_3	19.18	12.10	139.22
T_4	17.00	10.78	125.13
T_5	18.29	12.46	128.74
T_6	18.34	13.20	136.06
T_7	16.26	12.98	130.51
T_8	20.59	14.13	140.73
SEm (±)	**1.26**	**1.08**	**1.26**
LSD(0.05)	**3.8**	**2.11**	**3.81**

Effect of organic sources of nutrients on tuber bulking rate (g $m^{-2}d^{-1}$)

TBR continued its increasing trend up to 80 DAP and thereafter it decreased in all the treatments which might be due to lesser efficiency of photosynthetic perceptive organ and consequently lower accumulation of photosynthate to the harvesting organ and also senescence of lower leaf. During 50-65 DAP, the maximum TBR (10.91 g $m^{-2}d^{-1}$) was achieved in the treatment T_8 (vermicompost @ 8 t ha^{-1} +biofertilizers), which was statistically at par with treatments T_5: crop residue @ 5t ha^{-1} + FYM @ 20 t ha^{-1} (9.58 g $m^{-2}d^{-1}$) and treatment T_3 (crop residue @ 5t ha^{-1} + biofertilizers) recording 9.30 $gm^{-2}d^{-1}$. The TBR increased gradually after 50 DAP and attained maximum during 65-80 DAP. During this period, highest TBR (14.26 g $m^{-2}d^{-1}$) was accounted in treatment T_8 (vermicompost @ 8 t ha^{-1} + biofertilizers) which remained statistically at par with treatment T_6 (vermicompost @ 10 t ha^{-1}) with a TBR of 13.27 g $m^{-2}d^{-1}$.

Effect of organic sources of nutrients on tuber yield of potato (t ha^{-1})

The total tuber yield of potato (Table 3) was influenced significantly due to different organic treatments. Potato crop receiving vermicompost @ 8 t/ha + biofertilizers (T_8) produced highest tuber yield (20.59 t ha^{-1}) which was statistically at par with treatments T_3: crop residue @ 5t ha^{-1} + biofertilizers (19.18 t ha^{-1}), T_6: vermicompost @ 10 t ha^{-1} (18.34 t ha^{-1}), T_5: crop residue @ 5t /ha + FYM @ 20 t ha^{-1}(18.29 t ha^{-1}) and T_4 : FYM @ 30 t ha^{-1} (17.00 t ha^{-1}). Experiments conducted on the same experimental site (Block Seed Farm, Adisaptagram) with same variety *Kufri Jyoti* using the recommended dose of fertilizers (150:100:100 NPK kg ha^{-1}) have, however, recorded higher yields viz., 23.90 t ha^{-1} (Anon, 2007-08) and 23.15 t ha^{-1} (Anon, 2008-2009). Amongst the organic treatments, higher tuber yield was obtained from treatments where biofertilizers were included. Ray and Mukhopadhaya (2000) also reported that seed treatment with biofertilzers (*Azotobacter* and *Phosphobacteria*) before planting increased the tuber yield of potato. The organic treatments have shown much higher yields than the control, signifying their

role in potato yield increment. Sood *et al.*, (2001) also reported that vermicompost as well as azotobacter with or without nitrogen, increased tuber yield of potato. Tripathi (1979) also recorded 14.6% higher tuber yield by incorporating FYM @ 30 t ha^{-1}. Mahapatra *et al.*, (2007) also reported that maximum yield of potato tuber (24.96 t ha^{-1}) where potato crop received NPK (10:26:26) along with 25% N as FYM. Comparing the average yields obtained from recommended dose of fertilizers with that of highest yield obtained from organic treatment (T_8), there is approximately 14 % higher yield in case of chemical fertilizer treated plants. This might be due to the lesser availability of nutrients supplied through organic sources as compared to inorganic source. However, constant use of organic sources may help in building up the soil health which may help to increase the production. Upadhyay *et al.* (2003) also observed that the high levels of productivity in potato production though cannot be obtained through organic sources of nutrients but maintains the soil fertility status as well as soil health over the years.

Effect of organic sources of nutrients on biochemical parameters (Ascorbic acid and Starch content) of potato (mg $100g^{-1}$)

The information provided in table 3 shows that the ascorbic acid and starch content of potato varies significantly with different treatments. The highest content of ascorbic acid was observed in case of treatment T_8 (14.13 mg $100g^{-1}$) which was statistically at par with all other treatments except treatments T_1, T_2 and T_4.Regarding the starch content, the maximum was recorded again with treatment T_8 where the crop is treated with vermicompost @ 8 t ha^{-1} + biofertilizers with a value of 140.73 mg 100g $^{-1}$ which is followed by treatment T_3 (crop residue @ 5 t ha^{-1} + biofertilizers). Treatment with FYM does not record a significant starch content having a value of 125.13 mg 100 g $^{-1}$ in T_4 and 128.74 mg $100g^{-1}$ in T_5 where the crop was treated with FYM @ 30t ha^{-1} and crop residue @5t ha^{-1} + FYM @ 20 t ha^{-1} respectively. The starch content in biofertilizers treated crop is significantly higher than other organic source treatment. From this table we see that there is not so significant effect of FYM with regard to biochemical parameters. This finding is also reported by Hassandokht *et al.,* (2000). Biofertilizers play a significant role in not only increasing the growth and yield of potato but also increases the ascorbic acid content as well as starch content of the tuber. This result is in conformity with the findings of Mahendran *et al.*, (1998). From this experiment, it can be concluded that the application of vermicompost along with bio-fertilizers enhance the growth as well as yield of potato. The results also showed that application of vermicompost or crop residue in combination with biofertilizers proved to be better yielder than their sole application. Application of FYM along with crop residue has shown better results than its sole application.

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