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Assessment of growth, yield and quality of potato under organic sources

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Abstract

A field experiment was conducted at farmer's field in Nainital district of Uttarakhand to know the response during 2021-2022 to know the response of potato variety Kufri Chipsona-2 to organic sources. The growth parameters and yield of potato were significantly influenced by the organic manures and chemical fertilizers. Maximum plant height (68.66 cm), number of haulms per hill (7.55), number of tubers per hill (8.33), weight of tuber per hill (626.66 g), dry matter content of tuber (26.30%), total soluble solids (5.03°B), specific gravity (0.975 g/cm³) and yield (245.60 g/ha) were recorded with the application of 100% recommended dose of NPK (160: 100: 120 kg/ha)+10 t FYM followed by 100% of recommended dose of NPK alone. Maximum number and weight of A and B grade tubers were recorded in treatment T₄ and T₅, respectively. The highest net income as well as benefit: cost ratio (1.25) was obtained with the application of 100% NPK.

Keywords: Chemical, organic nutrition, potato, tuber yield, vermicompost

Introduction

Organic farming is getting momentum because people prefer to consume vegetable free from chemical residues. On the other hand, the ecological concerns regarding residual toxicity due to indiscriminate and excessive use of chemicals by means of fertilizers and pesticides and their harmful effects on soil health as well as on biodiversity indicates an urgent need for a shift to available organic resources as manure along with fertilizers. The organic manures not only supply the nutrients but also improve the physical environment for better plant and tuber growth. The manures are low analysis nutrient carriers yet play a significant role in the fertilizer economy. The yields obtained with combined use of organic manures and fertilizers are higher than fertilizer alone. As such, the knowledge of fertilizers equivalent to organic manures is essential for making a sound fertilizers programme. The manures alone are poor sources of nitrogen for obtaining optimum potato yield but improve organic carbon status of soil.

Presently, FYM is a major source of organic matter and nutrients, besides poultry manure and vermicompost. These organic sources generally contain low level of nutrients and are required in higher amounts to fulfil the needs of crop, therefore, it is essential to supply the nutrient in integrated manner. By this way the dependence on fertilizer can be reduced in the days to come and in the mean time the soil will also develop its quality and fertility status by the continuous use of organic sources. Application of organic sources in conjunction with fertilizers ensures environmental safety, besides improving the fertilizer use efficiency and tuber yield in potato crop Raghav *et al.* (2008) [4]. The quantity of nutrient taken up by a crop is not necessary an indication of responsiveness to fertilizers but potato because of poorly developed root system is highly responsive to the applied plant nutrients.

Materials and Methods

The present experiment was conducted at farmer's field at village Chandrapur navad, Kaladhudi, Nainital, Uttarakhand during rabi season of 2020-2021. The soil of the experiment field was sandy loam having pH 6.12 and available nitrogen (129.02kg/ha), phosphorous (20.93kg/ha), K (169.12kg) and organic carbon (0.85%). Experiment was conducted in randomized block design with three replications having eight treatment combinations. The details are as follows:-

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T₁-Recommended dose of fertilizer (RDF) *i. e.*, 160: 100: 120 kg NPK /ha

T₂- FYM 10 t/ha +100% RDF

T₃-FYM 15 t/ha +75% RDF

T₄- FYM 20 t/ha+ 75% RDF

T₅- FYM @ 15 t/ha+ poultry manure @ 2.5 t/ha

T₆- FYM @ 20 t/ha + poultry manure @ 2.5 t/ha

T₇-FYM @15 t/ha + vermicompost @ 5 t/ha

T₈- FYM @20 t/ha + vermicompost @5.0 t/ha

As per treatment, FYM was applied during final and preparation. Half of nitrogen, full phosphorus and potash were applied as basal and remaining half of nitrogen was applied as top dressing at the time of earthingup (30DAP). The crops were raised by following the recommended package of practice for the region. The observations were recorded on plant height (cm), number of haulms per hill, tuber yield (t/ha), dry matter content of tubers (%), specific gravity (g/cm³) and benefit: cost ratio. Benefit cost ratio (B: C) was worked out on prevailing market prices. The data were subjected to analysis of variance (ANOVA) through computer by using STPR-3 programme, designed by Department of Mathematics and Statistics, College of Basic Sciences and Humanities, G. B. P. U. A. & T., Pantnagar, Uttarakhand.

Results and Discussion

It is evident from the table 1 that plant height was significantly affected by various treatments at all the growth stages. Treatment T₁ (Recommended dose of fertilizer (RDF) *i. e.*, 160: 100: 120 kg NPK /ha) resulted in significantly maximum plant height (65.00 cm) as compared to other treatments. The results obtained revealed that plant height increased with the increase of nutrient level. The probable reason for increasing plant height might be due to more uptake of nitrogen during growth period resulting in increase in cell size, elongation and enhancement of cell division which ultimately increased the plant growth. Thus, the plant height was much superior to the plants in the plots receiving less amount of nitrogen. These findings are in agreement with Chandra *et al.* (2015) [1] Singh *et al.* (2016) [7] Nagar *et al.* (2019) [3]. The data pertaining to number of haulms per hill was significant for various treatments. The maximum number of haulms per hill was recorded in treatment T₁ (Recommended dose of fertilizer (RDF) *i. e.*, 160: 100: 120 kg NPK /ha). These findings support the observations Raghav *et al.* (2009) [5] who reported linear increase in the tuber yield and haulm yield by increasing levels of NPK in the presence of FYM.

The yield of potato tubers significantly affected with different

nutritional treatments. The highest tuber yield per ha (25.32t/ha) was found with application of recommended dose of fertilizer (RDF) *i. e.*, 160: 100: 120 kg NPK /ha (T₁) followed by treatment T₄ (FYM 20 t/ha+ 75% RDF). Though the yield was less in the organic treatments but inclusion of organic manures with inorganic fertilizers positively influenced the soil health via improving the soil organic matter status. Thus, combination of inorganic and organic fertilizers is more beneficial as compared to their individual effects. The results are in close conformity with Yadav *et al.* (2014) [8].

Marked distinction in the quality characters *viz.*, per cent dry matter content and specific gravity of tubers was found due to variation in fertility levels. All the quality characters were increased with increasing level of nutrients. Highest per cent dry matter content of tubers (24.50) was recorded in treatment T₁ (Recommended dose of fertilizer (RDF) *i. e.*, 160: 100: 120 kg NPK/ha which was closely followed by treatment T₄ (FYM 20 t/ha+ 75% RDF). This might be because of higher accumulation of carbohydrates in tubers at higher level. Our results tally with the Chettri *et al.* (2002) [2]. Highest specific gravity was recorded (0.975 g/cm³) recorded in treatment T₅ (FYM @ 15 t/ha+ poultry manure @ 2.5 t/ha) but it was not significantly differ from other treatments. This might be due to the increase in the levels of NPK supplied by organic and inorganic combination not only increases the size but percent dry matter content of tubers too. Silva *et al.* (1980) [6] have also reported that the N rate had no significant effect on specific gravity.

Economics of various treatments

It is evident from table 1 that treatment T₁ (Recommended dose of fertilizer (RDF) *i. e.*, 160: 100: 120 kg NPK /ha) had highest cost: benefit ratio *i. e.*, 1:1.25 followed by treatment T₅ (FYM @ 15 t/ha+ poultry manure @ 2.5 t/ha)

On the basis of present investigation it can be concluded that the highest tuber yield was obtained from the application of inorganic fertilizers *i. e.*, 160: 100: 120 kg NPK /ha (RDF) followed by the organic and inorganic combination of nutrients *i. e.*, treatment T₄ (FYM 20 t/ha+ 75% RDF) and T₈ (FYM @ 20 t/ha + vermicompost @5.0 t/ha). Application of inorganic fertilizer (T₁) gave maximum B: C ratio (1.25) followed by organic and inorganic combination *i. e.*, T₅ (FYM @ 15 t/ha+ poultry manure @ 2.5 t/ha). Since the differences in B: C ratio between treatment T₁ and T₅ seems not too wide. These differences come due to incorporation of farmyard manure in treatment T₅ which could have sustainable effect on the soil health in future.

Table 1: Effect of various organic sources on growth, yield, economics and quality of potato

Treatments	Plant height (cm)	Number of haulms per hill	Tuber yield (t/ha)	B:C ratio	Dry matter content of tubers (%)	Specific gravity (g/cm ³)
T ₁	65.00	5.58	25.32	1.25	24.50	0.961
T ₂	59.00	5.25	20.92	1.05	23.70	0.935
T ₃	60.00	5.08	21.64	1.05	23.93	0.946
T ₄	61.00	5.29	22.60	1.13	24.40	0.955
T ₅	59.00	5.55	20.06	1.20	23.03	0.975
T ₆	60.00	5.01	20.91	1.03	23.09	0.907
T ₇	55.00	4.95	20.76	1.08	23.13	0.908
T ₈	57.00	5.01	21.79	1.03	24.65	0.868
C.D at 5%	5.86	NS	2.12	-	NS	0.057

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