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Priyanka Gangele
Department of Horticulture Science, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (Madhya Pradesh), India.

KS Tomar
Department of Horticulture Science, College of Agriculture, RajmataVijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (Madhya Pradesh), India.

Correspondence
Priyanka Gangele
Department of Horticulture Science, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (Madhya Pradesh), India.

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Effect of different levels of potassium fertilizer with and without vermi compost on potato yield

Priyanka Gangele and KS Tomar

Abstract
Potassium plays a role in sugar translocation and starch synthesis in plants. Due to the high starch of the potato tuber, K is an important nutrient in tuber development. Potassium and vermi compost plays an essential role in influencing potato yield and quality. Hence, application of recommended dose of fertilizers and vermicompost indicated maximum yield in Potato. A field experiment was carried out in Rabi season during the year 2016-17 at the research farm of Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) in which eight combinations viz., K_1C_0 (180:100:30 kg/ha) without Vermicompost (T_1), K_1C_1 (180:100:30 kg/ha) + Vermicompost (20 t/ha) (T_2), K_2C_0 (180:100:60 kg/ha) without Vermi compost (T_3), K_2C_1 (180:100:60 kg/ha) + Vermicompost 20 t/ha (T_4), K_3C_0 (180:100:90 kg/ha) without vermicompost (T_5), K_3C_1 (180:100:90 kg/ha) + vermicompost (20 t/h) (T_6), K_4C_0 (180:100:120 kg/ha) (T_7), K_4C_1 (180:100:120 kg/ha) + vermicompost (20t/ha) (T_8) were studied in Randomized Block Design with three replications. Various yield parameters viz., Number of rotted tubers plant^{-1}, total tuber yield per plot (kg), total tuber yield per ha, Marketable yield per plot (kg), Marketable yield per ha and economics was also worked out. The yield of any crop is the final index of the experiment which indicates the success or failure of any treatment with this view the tuber yield of potato was recorded. The treatment K_3C_1 was recorded significantly superior and gave maximum (26.92 t) total yield of tubers hectare^{-1} and which were at par with treatment K2C1 (25.70 t) while the lowest total yield hectare $^{-1}$ was noted in K1C0 (16.01 t). Integrated use of vermicompost and potassium fertilizer gave the best result in terms of number and yield of large sized tubers. 150 kg k_2O+ 20 t Vermicompost gave siginificantly higher yield and B: C ratio.

Keywords: Potato, Potassium, Vermicompost, Yield.

Introduction
Potato (*Solanum tuberosum* L.) belongs to family Solanaceae and genus Solanum and is native of the Andean plateau of South America. The widely grown potato is an autotetraploid with 2n=48. Potato world's fourth important food crop after wheat, rice and maize (Rana, M.K. 2008) [5]. The potato is unique and different from other crops in that sense the food material is stored in underground stem parts called tubers. Potato provides a source of low cost energy to the human diet and it is the rich source of starch, vitamin C and B and minerals. It is a heavy feeder of plant nutrients having very high requirement of nitrogen, phosphorus, potassium and other nutrients. Potato is known as protective food because potato protein is rich in lysine which is one of the most important amino acid. Potato contains – water (74.7-75%), sugar and starch (22.9%) each, fat (0.1%), minerals &vitamins (0.6%) & protein (1.21-2%). Potato ranks fourth among major food crops of the world with an area of 19.26 million ha, production & productivity of 320.71 million tons and 16.64 tons/ha, respectively (FAO. 2008). In India the area, production and productivity of potato are 2.085 million ha, 48.096 million tons and 23.07 tons per ha in 2015-16 (NHRDF, 2015-16). In Madhya Pradesh the total area under potato cultivation is 1973.2 thousand ha, with production 41555.4 thousand metric tons and productivity is 21.1 mt/ha (NHB 2014). However, the potato productivity in India is still very poor as compared to many countries of Europe and U.S.A.

Growth, yield and quality of potato depend on nutrient availability in soil, which is directly related to the judicious application of manures and fertilizers. Using of vermin compost is now a global movement for the second green revolution that emphasizes on composting. This mixture is made by earthworm's activities which are necessary for soil improvement and farm production, raw materials and various microorganisms which decompose organic wastes and convert them into suitable nutritional elements particularly NPKS. As the researchers stated

the application of recommended dose of fertilizers and vermicompost indicated maximum yield in Potato (Patil, 1997) [4]. Hence, the present investigation was undertaken to study "effect of different levels of potassium fertilizer with and without vermincompost on yield of potato (*Solanum tuberosum* L.)".

Material and Methods

The materials used and the methods adopted during the course of present investigation entitled **"Effect of different level of Potassium with and without Vermicompost in Potato variety kufri chipsona-1"** was carried out in the experimental area of the Nursery, Department of Horticulture, College of Agriculture, Gwalior during the winter season of 2016-17 under the agro-climatic and soil conditions of Northern Madhya Pradesh. The nursery of College of Agriculture, Gwalior is situated at 26º 13 N latitude and 78º 14' E longitudes at an altitude of 211.5 m above sea level in Gird belt (MLS). It has a subtropical climate with hot and summer where maximum temperature exceeds 45^0 C in May-June. The winters are cold and the minimum temperatures reaches as low as 2^0 C in December and January. Frost is expected from last week of December to first week of February. Usually monsoon arrives in the second fortnight of June and lasts till September. The soil of the experimental field was clay in texture with uniform topography. In order to determine the textural class and fertility status of the experimental area, the soil samples were collected randomly up to a depth of 20 cm from each plot with the help of soil auger before sowing from the experimental field. Primary samples were mixed to prepare and composite soil sample from each replication was drawn to study physico-chemical properties of the experimental field. The experiment was laid out in Randomized Block Design (RCBD) with three replications. Each replication consists of 8 treatments. All the treatments were randomized separately in each replication and size of each plot 3.00 x 3.00 sq.m. The crop potato (Variety: Kufri chipsona-1) was sown with spacing of 60 cm X 20 cm. The observations on number of rotted tubers plant^{-1}, total tuber yield per plot (kg), total tuber yield per ha, marketable yield per plot (kg), marketable yield per ha and economics was also worked out. The data based on the mean of individual plants selected for observation were statistically analyzed described by Panse and Sukhatme (1985) [3] to find out overall total variability present in the material under study for each character and for all the populations.

Results and Discussion

Number of rotted tubers plot-1

The mean number of rotted tubers plant^{-1} of different treatment is given in Table 1. Significantly minimum 24.80, 26.73, 26.86 and 33.66 number of rotted tubers plot^{-1} were recorded in the treatments K_3C_1, K_2C_1, K_3C_0, K_2C_0 respectively and which were at par with each other. The number of rotted tubers was observed the maximum in treatment K_1C_0 without vermin compost.

Table 1: Number of rotted tubers plot^{-1} is influenced by different levels of potassium with and without vermicompost.

S.No.	Treatment Combinations	No of rotted tubers plot^{-1}
T_1	K_1C_0	50.07
T_2	K_1C_1	42.06
T_3	K_2C_0	33.66
T_4	K_2C_1	26.73
T_5	K_3C_0	26.86
T_6	K_3C_1	24.80
T_7	K_4C_0	40.93
T_8	K_4C_1	40.66
S E m ±		**3.855**
C.D. at 5%		**11.689**

Total yield of tubers plot^{-1} (kg)

The total yield of tubers plot^{-1} was recorded treatment wise and the mean value are depicted in Table 2. The treatment K_3C_1 was recorded significantly superior and gave maximum (24.234 kg plot^{-1}) total yield of tubers plot^{-1} followed by treatment K_2C_1 (23.134 kg plot^{-1}) which were at par with each other. While, the lowest 14.41 kg total yield of tubers plot^{-1} was noted in treatment K_1C_0 which recorded potassium only without vermin compost.

Total yield of tubers ha^{-1} (t)

The yield of any crop is the final index of the experiment which indicates the success or failure of any treatment with this view the tuber yield of potato was recorded. The data for the total yield of tubers plot^{-1} under different treatments were recorded and converted into total yield of tubers hectare^{-1} (tone).

Table 2: Total yield of tubers plot^{-1} (kg) and hectare^{-1} (ton) is affected by different levels of potassium with and without vermicompost.

S.No.	Treatments	Total yield of tubers plot^{-1} (kg)	Total yield of tubers ha^{-1} (t)
T_1	K_1C_0	14.41	16.01
T_2	K_1C_1	15.08	16.76
T_3	K_2C_0	17.60	19.56
T_4	K_2C_1	21.98	24.42
T_5	K_3C_0	18.88	20.97
T_6	K_3C_1	23.08	25.64
T_7	K_4C_0	16.35	18.16
T_8	K_4C_1	16.87	18.75
SEm±		**0.377**	**0.418**
C.D. at 5%		**1.154**	**1.281**

The total yield of tubers hectare^{-1} as affected by different level of potassium with and without vermicompost is presented in Table 2. The treatment K_3C_1 was recorded significantly superior and gave the maximum (26.921 t) total yield of tubers hectare^{-1} and which was at par with treatment K_2C_1 (25.601 t). The similar findings was also reported in increase in yield with organic manure was also reported by Shambhavi *et al.* (2008) [6]. While, the lowest (16.01 t ha$^{-1)}$ total yield hectare^{-1} was noted in K_1C_0 without vermicompost. The increase in total yield due to K2O fertilization may be due to stimulating effect of potassium on photosynthesis, phloem loading and translocation as well as synthesis of large molecular weight substances within storage organs. Moinuddin *et al.* (2003) [2] also observed increase in potato tuber yield due to potassium application.

Marketable yield of tubers plot^{-1} (kg)

The marketable tuber yield plot^{-1} and hectare^{-1} as affected by different treatment is presented in Table 3.

Table 3: Marketable yield of tubers kg plot^{-1} and ton ha^{-1}as affected by different levels of potassium with and without vermicompost.

S.No.	Treatments	Marketable yield of tubers plot^{-1} (kg)	Marketable yield of tubers ha^{-1} (t)
T_1	K_1C_0	13.47	14.96
T_2	K_1C_1	14.47	16.07
T_3	K_2C_0	17.49	19.43
T_4	K_2C_1	18.95	21.06
T_5	K_3C_0	18.39	20.43
T_6	K_3C_1	20.50	22.87
T_7	K_4C_0	15.95	17.72
T_8	K_4C_1	16.17	17.96
SEm±		**0.345**	**0.382**
C.D. at 5%		**1.056**	**1.171**

Significantly maximum 21.556, 20.006kg plot^{-1} and 24.041, 22.23 t/ha marketable tuber yield were recorded under the treatments K_3C_1 and K_2C_1, respectively which were at par with each other. However, the lowest 13.47 kg plot^{-1} and 14.96 t ha^{-1} marketable tuber yield was observed in treatment K_1C_0 without vermicompost. The highest tuber yield under integrated use of inorganic and organic reflects the greater nutrient availability under these treatments. The similar finding was reported by Jaipaul *et al*. (2011) [1].

Conclusion

On the basis of present investigation, it is concluded that 90kg Potassium with Vermi compost (20t/ha) for the processing variety Kufri Chipsona-1 responded well in terms of growth, yield and yield attributing characters in Gird region of Madhya Pradesh. Higher money value and less cost of cultivation are desirable traits for getting higher returns. Hence economics of the treatments was work out. It is revealed from the data obtained that a significantly maximum marketable tuber yield of 22.87 tone ha^{-1} was obtained in treatment K_3C_1 with net return of Rs206602 ha^{-1} and cost benefit ratio 1: 4.83 as compared to other treatments.

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