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Effect of different levels of potassium fertilizer with and without vermicompost on morphological parameters of potato (*Solanum tuberosum* L.)

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Abstract
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 morphological parameters viz., Plant height (cm), Number of leaves plant^{-1}, Length of leaves (cm) and Diameter of stem (cm) was also worked out.

Keywords: Potato, potassium, vermicompost, morphological parameter

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.
Alam *et al.,* (2007) [1] in a study on the effect of vermicompost and chemical Fertilizers on growth, yield and yield Components of potato stated that the plant height, foliage coverage, number of main stem per hill, fresh weigh, dry weight of shoot, numbers of tuber per hill, percent dry matter of tuber, weight of tubers per hill, tuber yield and dry weight of tuber were significantly affected by the treatments at different growth periods. The use of organic elements has long been considered as an effective means of improving the structure and fertility of the soil.

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 Plant height (cm), Number of leaves plant^{-1}, Length of leaves (cm) and Diameter of stem (cm) was also worked out. The data based on the mean of individual plants selected for observation were statistically analyzed described by Chettri *et al*. (2002) [2] also found that the application of potash increase the dry matter production. The similar findings was also reported by Zelelew *et al*. (2016) [4]. The application of vermicompost 20t/ha was found significantly superior in number of leaves plant^{-1} leaf length, diameter of stem, over vermicompost (0 t/ha). The similar finding was also reported by Kumaraswamy (2002) [3].

Results and Discussion

Plant height (cm)

The mean Plant height of different treatment is given in Table 1. Significantly maximum Plant height at 30, 60 and 90 days after planting 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. While, the highest 59.80cm Plant height at 90 DAP was noted in treatment K_3C_1 which recorded potassium only without vermicompost.

Table 1: Plant height (cm) as influenced by different levels of potassium with and without vermicompost at 30, 60 and 90 days after planting.

S. No.	Treatments	Plant height (cm) at		
		30 DAP	60 DAP	90 DAP
T_1	K_1C_0	23.61	43.64	54.05
T_2	K_1C_1	25.18	45.24	55.31
T_3	K_2C_0	27.23	47.32	57.73
T_4	K_2C_1	28.45	48.51	58.95
T_5	K_3C_0	27.85	47.90	58.29
T_6	K_3C_1	29.72	49.70	59.80
T_7	K_4C_0	25.81	45.86	56.05
T_8	K_4C_1	26.62	46.66	57.07
SEm±		1.147	1.153	1.020
C.D. at 5%		3.514	3.530	3.124

Number of leaves plant^{-1}

The mean number of leaves plant^{-1} of different treatment is given in Table 2. Significantly maximum Number of leaves plant^{-1} was recorded at 30, 60 and 90 days after planting in the treatments K_3C_1, K_2C_1, K_3C_0, K_2C_0 respectively. While, the highest 3.47cm Number of leaves at 90 DAP was noted in treatment K_3C_1 which recorded potassium only without vermicompost.

Table 2: Number of leaves plant^{-1} as affected by different levels of potassium with and without vermicompostat 30, 60 and 90 days after planting.

S. No.	Treatment Combinations	Number of leaves plant^{-1}		
		30 DAP	60 DAP	90 DAP
T_1	K_1C_0	7.80	13.27	14.87
T_2	K_1C_1	8.67	13.73	15.80
T_3	K_2C_0	10.00	15.33	19.00
T_4	K_2C_1	11.53	16.87	20.13
T_5	K_3C_0	11.00	16.47	19.73
T_6	K_3C_1	11.87	17.87	21.53
T_7	K_4C_0	9.47	14.40	17.13
T_8	K_4C_1	9.67	15.00	17.80
SEm±		0.218	0.386	0.852
C.D. at 5%		0.669	1.182	2.610

Length of leaves (cm)

The mean Length of leaves (cm) of different treatment is given in Table 2. Significantly maximum Length of leaves (cm) was recorded at 30, 60 and 90 days after planting in the treatments K_3C_1, K_2C_1, K_3C_0, K_2C_0 respectively. While, the highest 5.06cm Number of leaves at 90 DAP was noted in treatment K_3C_1 which recorded potassium only without vermicompost.

Table 3: Leaf length (cm) as affected by different levels of potassium with and without vermicompostat 30, 60 and 90 days after planting.

S. No.	Treatment combinations	Leaf length (cm)		
		30 DAP	60 DAP	90 DAP
T_1	K_1C_0	3.47	3.67	3.97
T_2	K_1C_1	3.50	3.70	4.00
T_3	K_2C_0	4.13	4.33	4.63
T_4	K_2C_1	4.31	4.52	4.83
T_5	K_3C_0	4.22	4.42	4.72
T_6	K_3C_1	4.56	4.76	5.06
T_7	K_4C_0	3.99	4.19	4.49
T_8	K_4C_1	4.03	4.23	4.53
SEm±		0.152	0.153	0.152
C.D. at 5%		0.467	0.470	0.467

Diameter of stem (cm)

The mean Diameter of stem (cm) of different treatment is given in Table 2. Significantly maximum Length of leaves (cm) was recorded at 30, 60 and 90 days after planting in the treatments K_3C_1, K_2C_1, K_3C_0, K_2C_0 respectively. While, the highest 3.47cm Diameter of stem at 90 DAP was noted in treatment K_3C_1 which recorded potassium only without vermicompost.

Table 4: Diameter of stem (cm) as affected by different levels of potassium with and without vermicompostat 30, 60 and 90 days after planting.

S. No.	Treatment Combinations	Diameter of stem (cm) at		
		30 DAP	60 DAP	90 DAP
T_1	K_1C_0	1.75	1.95	2.15
T_2	K_1C_1	2.06	2.26	2.46
T_3	K_2C_0	2.56	2.76	2.96
T_4	K_2C_1	2.72	2.92	3.12
T_5	K_3C_0	2.65	2.85	3.05
T_6	K_3C_1	3.07	3.27	3.47
T_7	K_4C_0	2.34	2.54	2.74
T_8	K_4C_1	2.45	2.65	2.84
SEm±		0.157	0.157	0.157
C.D. at 5%		0.480	0.480	0.480

The morphological parameters as affected by different level of potassium with and without vermicompost are presented in Table 2 and 4. The treatment K_3C_1 was recorded significantly superior and gave the maximum 21.53/plant Length of leaves (cm) and maximum 3.47cm Diameter of stem. Chettri *et a*l. (2002) [2] also found that the application of potash increase the dry matter production. The similar findings were also reported by Zelelew *et al*. (2016) [4].

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. Potassium @ 90kg with vermicompost was observed best for morphological parameters (i.e. plant height, number of leaves plant^{-1}, leaf length, and diameter of stem) was recorded maximum in this treatment.

It is revealed from the data obtained that a significantly maximum Plant height (59.80cm), Number of leaves (3.47cm), Length of leaves 5.06cm and Diameter of stem (3.47cm) ware recorded at 90 DAP in each treatment.

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