Assessment ofpotato(*Solanumtuberosum*L.) growth attributes under natural farming system in gird region of Madhya Pradesh

Abstract

The present study was conducted at ICAR-CentralPotatoResearchInstitute- RS, research farm Gwalior during winter (*Rabi*) season of 2022The experiment was laid out using Randomized Design with treatmentsT_1: Control, T_2: Inorganic practices (standard technology), T_3: NADEP compost @ 25 t/ha + *Azotobacter*@ 1L/ha + PSB @ 1L/ha, T_4: T_3+ FYM @ 25 t/ha, T_5: T_3+Vermicompost @ 7.5 t/ha, T_6: T_3+ neem cake @ 5 t/ha + foliar spray of copper oxychloride @ 3 g/L (for management of foliar diseases), T_7: Integrated practice [90% RDF through inorganic sources {urea, SSP, MOP}, 10% RDF through organic sources i.e., FYM @ 25 t/ha. The findings of results reveals that treatment T_7 found better for growth parameters of potato *i.e.*, maximum plant emergence percentage (92.88%), maximum plant height (50.250 cm and 73.700 cm at 50 DAP and at harvest, respectively), highest number of stems (6.35 and 6.89 at 50 DAP and at harvest) per plant, Highest number of compound leaves (47.950 and 58.250 at 50 DAP and at harvest), Highest fresh haulm weight (0.245 kg and 0.382 kg at 50 DAP and at harvest), highest dry haulm weight (21.80 g and 25.20 g at 50 DAP and at harvest), Highest root fresh weight (15.55 g and 18.22 g) at 50 DAP and at harvest), Highest root fresh weight (7.85 g and 8.94 g at 50 DAP and at harvest), maximum root length per plant (13.40 cm) and lowest values found in treatment T_1 – Control.

INTRODUCTION

Potato (*Solanum tuberosum* L.)is very crucial food crop in the world. It is also referred to as economical food as it provides much nutrition in low cost. Potatoes are rich in starch, amino acids (tryptophane and isoleucine) vitamins (C, B_1) and minerals. It also contains carbohydrates (20.6%), protein (0.3%) and ash (0.9%), crude fiber (1.1%). It is mostly used for vegetable purpose but has certain industrial value also it can be used for making chips, French fries and many packaged items.

Among vegetable crops, potatoes take up the most land. It requires a maximum temperature of less than 35^0C and below 20^0C as minimum temperature. It requires a temperature ranging from 16 to 22^0C and slightly acidic conditions for tuberization. India accounts for 7.58% of potato production in the world (FAO STAT, 2018) and ranks 2nd in its

area and production after China. UP is the leading potato producer in India. In Potato is grown on 2.05 million hectares in India, with a production of 48.66 million tones and an average yield of 23670 kg/ha (Agriculture statistics at a glance, 2020). MP comprises 7.36 and 7.43% of the country's potato area and production, respectively.

The role of soil organic carbon in maintaining the soil fertility is well known to everyone from the past times. The maintenance of soil health is the fore most concern in present time when we are concerned about increasing the productivity per unit area. We all know that by the intensive use of chemical fertilizers the quality of the soil is degrading day by day. Due to the health issues too, we need to shift from the inorganic to organic crop production to maintain the soil health and productivity.

Among the organic sources, FYM is a well-known source which releases nutrient into the soil after the proper decomposition by the microorganisms. Its long-term addition results in improved biological activity (Colonis*et al,* 1992 and Fauci and Dick, 1994). Vermi-compost also adds organic matter and makes the soil fertile. Organic matter in soil acts as a storehouse of nutrients. Neem cake along with the supply of nutrients also provides protection against insect pest.

Biofertilizers like *Azotobacter*& PSB have also been found beneficial to improve nutrient status in soil like nitrogen and phosphorus. PSB secrets organic acids which lowers the soil pH bringing about the dissolution of bound form of phosphorus (Gaur and Rao, 1984).

MATERIALS AND METHODS

Experimental site:

The experiment was carried in the ICAR-CentralPotatoResearchInstitute-RS, research farm inGwaliorwhichislocatedat26^{o}13’ Northlatitude, 78^{o}14’ East longitude and 206 meters above mean sea levelintheNorthtractofM.P.

Climatic Conditions:

Gwalior's climate is subtropical, with summer temperatures reaching up to48^{o} C and minimum temperature as low as 4.0^{o}C during the winterseason. The annual rainfall ranges between 750 and 800 mm, with the majority falling between the end of June and end of September, with only a few showers in the wintermonths. Meanmonthlymeteorologicaldata(maximumandminimumtemperature, relative humidity, evaporation and precipitation) were collected at the Meteorological Observatory-College ofAgriculture, Gwalior during the crop growth season. According to the data the total rainfall received during the crop growth period was 17.4 mm. during the crop growing period theaverage maximum and lowest temperature were 28°cand10°c,respectively.Therelativehumidityrangedfrom37.2%to73.4%.

Design	:	Randomized Block Design
Treatment	:	7
Replication	:	4
Total number of plots	:	28
Net plot size	:	3.6 m x 3.6 m
Number of plants for observation per plot	:	5
Plot to plot distance	:	1.2 m
Distance between replication	:	1.2 m
Crop	:	Potato (*Solanum tuberosum* L.)
Variety		K. Mohan
Season	:	2022-23
Date of planting	:	16–11–2022
Fertilizers (RDF)	:	N, P_2O_5, K_2O 180:80:120kg ha^{-1}, respectively

Treatment details

T_1: Control, T_2: Inorganic practices (standard technology), T_3: NADEP compost @ 25 t/ha + *Azotobacter*@ 1L/ha + PSB @ 1L/ha, T_4: T_3+ FYM @ 25 t/ha, T_5: T_3+Vermicompost @ 7.5 t/ha, T_6: T_3+ neem cake @ 5 t/ha + foliar spray of copper oxychloride @ 3 g/L (for management of foliar diseases), T_7: Integrated practice [90% RDF through inorganic sources {urea, SSP, MOP}, 10% RDF through organic sources i.e., FYM @ 25 t/ha.

Observations taken:

1. Plant emergence (%)

This observation was made with the goal of determining the influence of various treatments on emergence. Plant emergence was recorded at 30 days after planting, when the emergence was complete.

2. Plant height (cm) per plant

At 50 days after planting and at harvest, the height of the main stem from the ground level to the apical bud (leaf apex) was measured with a meter scale.

3. Number of shoots(stems) per plant

At 50 days after planting and at harvest, the number of shoots sprouting from the main stem of each tagged plant was counted.

4. Number of compound leaves per plant

At 50 DAP and harvest, the number of compound leaves on each tagged plant in all treatments was counted.

5. Fresh haulm weight (g) per plant

The plant's fresh haulm weight (g) was recorded using an electronic weighing scale at 50 DAP and at harvest.

6. Dry haulm weight (g) per plant

The plant's dry haulm weight was determined by dehydrating the plants first by sun drying and then oven drying, and then calculating the weight using an automated weighing scale at 50 DAP and harvest.

7. Root fresh weight (g) per plant

The fresh weight of the root (g) was measured at 50 DAP and during harvesting using an electronic weighing scale.

8. Root dry weight (g) per plant

The dry weight of the root was determined after dehydrating the plant’s roots first by sun drying and then oven drying, and then using an electronic weighing scale at 50 DAP and harvest.

9. Root length (cm)

At 50 DAP, the plant's fresh root length (cm) was measured with a meter scale.

Data analysis: The data based on the mean of individual plants selected for observation were statistically analyzed described by Panse and Sukhatme (1985) to find out overall total variability present in the material under study for each character and for all the populations.

RESULTS AND DISCUSSION

A. Growth parameters

1. Plant emergence (%)

According to the data recorded, the treatments were not affected significantly. Analyzed data in table 1 reveals that maximum plant emergence percentage (92.88%) was recorded in treatment T_7(Integrated practice (90% inorganic practices& 10% organic),followed by treatment T_2RDF(92.803) and the minimum plant emergence percentage was recorded in T_3- NADEP + azotobacter + PSB (91.04 %).According to Pandey *et al*. (2017) tuber emergence depends on the physiological stage and sprouts present on the tubers.

2. Plant height (cm)

The maximum plant height (50.250 cm and 73.700 cm at 50 DAP and at harvest, respectively) was obtained with T_7 at all the stages of the crop growthwhich was significantly higher over other treatments except T_1. The minimum plant height (35.250 cm, and 47.450 cm at 50 DAP and at harvest respectively) was obtained with T_1. This could be due to the vital role of treatments, tallest plants attained maximum height due to integrated availability of nutrients, at early growth stages fertilizers supported growth by supplying proper nutrients and plant height increased progressivelyfastand at later growth stages manure played a crucial role in supplying proper nutrients till maturity.Therefore, more cell division, cell expansion and enlargement resulted in higher plant height. Singh *et al*. (2018) also reported similar findings in potato.

3.Number of stems per plant

Number of stems at various growth stages have been presented in the table 1. Highest number of stems (6.35 and 6.89 at 50 DAP and at harvest) per plant have been reported in T_7. This is due tocontinuous availability of nutrients. Therefore, more cell division and cell enlargement, hence,a greater number of stems (Singh *et al.*,2018).

4.Number of compound leaves per plant

Number of compound leaves at various growth stages have been presented in the table 1. Highest number of compound leaves (47.950 and 58.250 at 50 DAP and at harvest) were recorded in treatment T_7. This is due to more and continuous availability of nutrients. Therefore, more cell division and cell enlargement, hence a greater number of compound leaves. Singh *et al.* (2018).

5.Fresh haulm weight (kg) per plant

Fresh haulm weight per plant at various growth stages have been presented in the table 1. Highest fresh haulm weight (0.245 kg and 0.382 kg at 50 DAP and at harvest) were recorded in treatment T_7. This is due to more and continuous availability of nutrients,therefore, more cell division and cell enlargement, hence a greater fresh haulm weight per plant (Singh *et al.,* 2018) but less fresh haulm weight is observed at harvest due to less availability of water.

6.Dry haulm weight (g) per plant

Dry haulm weight per plant at various growth stages have been presented in the table 1. Highest dry haulm weight (21.80 g and 25.20 g at 50 DAP and at harvest) were recorded in treatment T_7 and T_2 respectively. This is due to more and continuous availability of nutrients. Therefore, more deposition of photosynthates as dry weight, hence a greaterdry haulm weight per plant(Singh *et al.*2018) but less dry haulm weight is observed at harvest due to various external factors.

7.Root fresh weight (g) per plant

Root fresh weight per plant at various growth stages have been presented in the table 2. Highest root fresh weight (15.55 g and 18.22 g) at 50 DAP and at harvest) were recorded in treatment T_7. This is due to more and continuous availability of nutrients. Therefore, more development of roots as fresh weight.

8.Root dry weight (g) per plant

Root dry weight per plant at various growth stages have been presented in the table 2. Highest root fresh weight (7.85 g and 8.94 g at 50 DAP and at harvest) were recorded in treatment T_7. This is due to more and continuous availability of nutrients. Therefore, more development of roots as dry weight.

9.Root length (cm)

The studies on root length (cm) per plant were done at 30 DAP and the data have been presented in table 2.According to the data recorded, the treatments were not affected significantly. Analyzed data reveals that maximum root length per plant (13.40 cm) was recorded in treatment T_7(Integrated practice (90% inorganic practices, 10% organic), and the minimum root length per plant was recorded in T_1- control plot (11.40 cm).

Table 1: Effect of treatments on plant emergence, plant height, number of stems per plant, fresh haulm weight and dry haulm weight

Treatments	Plant emergence (%)	Plant height		Number of stems per plant		Fresh haulm weight (kg)		Dry haulm weight (g)	
		50 DAP (cm)	at Harvest (cm)	at 50 DAP	at Harvest	at 50 DAP	at Harvest	at 50 DAP	at Harvest
T1	92.65	35.2	47.4	3.83	4.55	0.111	0.1534	16.540	18.775
T2	92.803	45.0	61.6	5.55	6.25	0.2278	0.20625	21.513	25.1975
T3	91.04	39.2	48.9	4.65	5.43	0.1373	0.1975	18.860	21.375
T4	91.700	41.0	60.9	4.25	5.60	0.1495	0.1762	18.763	20.995
T5	91.89	41.5	55.4	4.96	6.30	0.1695	0.17395	21.484	23.365
T6	91.73	42.5	59.0	4.05	6.28	0.1977	0.1828	19.530	22.285
T7	92.88	50.2	73.7	6.35	6.88	0.245	0.238	21.804	23.8075
S.Em ±	**0.98**	**1.9**	**3.9**	**0.41**	**0.25**	**0.0231**	**0.015**	**0.937**	**0.275**
CD at 5%	**N.S**	**5.8**	**11.9**	**1.22**	**0.77**	**0.69188**	**0.0470**	**2.804**	**0.821**

Table 2: Effect of treatments on root fresh weight, dry weight and root length of potato

Treatments	Root fresh weight (g)		Root dry weight (g)		Root length (cm)
	At 50 DAP	At harvest	At 50 DAP	At harvest	
T1	7.993	13.883	3.813	3.167	11.400
T2	13.473	15.891	5.721	7.359	13.200
T3	10.685	11.181	2.454	5.889	12.200
T4	8.103	10.524	3.079	4.294	11.450
T5	13.183	16.300	5.532	7.163	11.550
T6	13.388	17.930	5.768	6.003	11.800
T7	15.55	18.22	7.8562	8.9425	13.400
S.Em ±	**2.032**	**2.086**	**1.043**	**1.09**	**1.061**
CD at 5%	**6.083**	**6.245**	**3.112**	**3.25**	**N.S**

Conclusion

It is conclude from the research trial that treatment T_7 - Integrated practice [90% RDF through inorganic sources {urea, SSP, MOP}, 10% RDF through organic sources i.e., FYM @ 25 t/ha] found better than other treatments for growth parameters of potato growing in grid region of Madhya Pradesh.

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