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PERFORMANCE OF POTATO VARIETIES FOR MORPHOLOGICAL AND YIELD CHARACTERS UNDER MALWA REGION OF MADHYA PRADESH

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ABSTRACT

A field experiment was conducted during rabi season of 2014 -15 at research farm, College of Agriculture, Indore (Madhya Pradesh) to study the morphological and yield characters of ten potato varieties in three replications. Results revealed that the variety Kufri Arun recorded maximum growth, yield attributes and yield over other cultivars. The variety Kufri Arun recorded maximum (63.92 cm) plant height followed by Kufri Chandramukhi (62.18 cm) While, the minimum plant height (43.50 cm) was recorded in variety Kufri Chipsona-2. Maximum diameter of stem was recorded in variety Kufri Arun (4.09cm) which was followed by Kufri Chandramukhi (4.03 cm) and minimum diameter of stem was observed in variety Kufri Chipsona- 4 (3.05 cm). Kufri Arun produced maximum 20.11 leaves per plant followed by Kufri Chandramukhi (19.13) While, minimum leaves were attained by variety Kufri Chipsona- 4 (15.06). Kufri Arun recorded maximum (497.23cm2) leaf area per plant followed by Kufri Chandramukhi (482.73 cm2) as compared to all other varieties and Kufri Chipsona- 4 (378.78 cm2) recorded the minimum value for leaf area per plant (cm2). Kufri Arun showed maximum dry weight (44.96 g) and minimum in variety Kufri Chipsona- 4(17.65 g). The variety Kufri Arun recorded maximum LAI (0.43), NAR (0.009), CGR (0.132) while Kufri Chipsona 4 recorded the least values LAI (0.29),NAR(0.002), CGR(0.032). The variety Kufri Arun obtained the maximum yield (292.55 q ha^{-1}) as well as maximum net income (Rs 192490/ha) with B:C ratio of 3.32 which was followed by K.Chandramukhi and K. Jyoti, while the minimum yield (223.44 q ha^{-1}) as well as net income (` 105160 r ha^{-1}) and cost benefit ratio (2.92) was recorded in Kufri Chipsona- 4.

Key words: Potato, varieties, growth, B:C ratio, yield

INTRODUCTION

Potato (*Solanum tuberosum* L.) is an annual, herbaceous, tuber crop of family Solanaceae that contains all the essential food ingredients required for maintaining proper health. Potato is a staple food in most of the countries and is a good and cheap source of food calories and its high starch content can meet the energy requirement of the people living in food deficit countries. Potato produces highest dry matter, carbohydrates, edible protein, minerals and vitamin C and B per unit area and time among the major food crops. It is a wholesome, nutritious and versatile food which can come to the rescue of the developing countries for alleviating hunger and malnutrition especially in shrinking land resources. The average composition of the potato is about 80% water, 2% protein and 18% starch. As a food, it is one of the cheapest and easily available sources of carbohydrates and proteins and contains appreciable amount of vitamin B and C as well as some minerals. Moreover, protein of potato is of high biological value (Qasim *et al.,* 2013).Crude protein content is 2.0% and the fat content is very low 0.1%. The ash consisting of minerals constitutes 1.0%. In addition potato tuber contains fiber, vitamins and glycoalkaloids in small quantities. Most European varieties, introduced earlier in India performed poorly because conditions in India are entirely different than those prevalent in temperate countries. A need was therefore, felt that potato cultivation in India cannot depend on exotic varieties and technologies and the country must have its own research and development programme for potato. Before recommendation of any variety / crop suitable for the region, it is pertinent to evaluate genotypes giving emphasis on the aspects of genotypic suitability and yield (Kanauyia and Manjai Phom 2016).Keeping this

in view the present study was carried out to select the suitable and improved varieties of

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potato having superior growth, yield characters and better economics variability for commercial production in Malwa condition.

MATERIALS AND METHODS

A field experiment was laid out at Research Farm College of Agriculture Indore, during (Rabi) 2014-2015. Indore is situated at an altitude of 555.5 meters above mean sea level (MSL). It is located at latitude 22.43^{o} N and longitude of 75.66^{o} E. It has subtropical climate having a temperature range of 21^{o} C to 45^{o} C and 6^{o} C to 31^{o} C in summer and winter seasons, respectively. The total rainfall received during crop growth period was 75.3 mm. The minimum and maximum temperature during crop growth period varied 5.3^{0}C to 18.79^{0}C and from 17.2^{0}C to 31.79^{0}C, with season's average values of 8.66^{0}C and 25.63^{0} C respectively. The soil of experimental site was predominantly clayey in texture. The organic carbon content (2.6gm/kg) and available nitrogen (216.0 kg ha^{-1}) were low. The available phosphorus (12.2 kg ha^{-1}) and potassium (420 kg ha^{-1}) were medium and high, respectively. The soil pH (7.6) and electrical conductivity (0.35 dS m^{-1}) of soil was found normal .The experiment was conducted in a randomized block design with ten varieties namely K.Chipsona 1, K.Chipsona 2, K.Chipsona 3, K.Chipsona 4, K.Chandramukhi, K. Arun, K.Lauvkar, K. Surya, K. Jawahar and K. Jyoti with 3 replications. Healthy, uniform, medium sized tubers (35 – 45 mm or 45 – 50 g) at the rate of 30 - 35q ha^{-1} were used for sowing. Shallow furrows were opened 6 cm apart and tubers were dibbled at a spacing of 60 cm row to row and 20 cm plant to plant. Observations were recorded on days to 50% germination, sprouts/plants, plant height (cm), leaves/plant, Leaf area (cm^{2}) the assimilatory surface area (A), Leaf area index (LAI), diameter of main stem, Net Assimilation rate, Crop growth rate, days to haulm cutting, days to maturity, tubers/plant, rotted tubers /wt/plant and total yield /marketable yield. Several economic indices are available to evaluate the profitability of cropping systems. The economics of different treatments was worked out on the basis of prevailing market price of inputs and produce.

RESULTS AND DISCUSSION

Morphological characters

The significant varietal differences in potato were noticed with respect to morphological characters (Table 1). The plant height of varieties differed significantly ranging from 63.92 cm (Kufri Arun) to 43.50 cm (Chipsona- 2). Variation in plant height was due to the inherent genetic makeup of the plant. Similar findings were reported by Kumar (2011). The diameter of the stem ranged from 4.09cm in Kufri Arun to 3.05 cm in Kufri Chipsona- 4. Maximum (20.11) leaves per plant were recorded in variety Kufri Arun followed by Kufri Chandramukhi (19.13), Kufri Jyoti (18.37) and Kufri chipsona-2 (18.82) as compared to other varieties. While, minimum leaves per plant were attained by variety Kufri Chipsona- 4 (15.06). Maximum leaf length (5.96 cm) was recorded in variety Kufri Arun followed by Kufri Chandramukhi (5.88 cm) and Kufri Jyoti (5.85 cm) as compared to other varieties, while minimum in variety Kufri Chipsona- 4 (5.06 cm). Similarly maximum leaf width of 4.70 cm was recorded in variety Kufri Arun which was followed by Kufri Chandramukhi (4.62 cm), Kufri Jyoti (4.52 cm) and at par with all other varieties over Chipsona varieties. While, the minimum leaf width (3.75 cm) was recorded in variety Kufri Chipsona- 4. Variety Kufri Arun recorded significantly maximum (497.23cm2) leaf area per plant followed by Kufri Chandramukhi (482.73 cm2). However, Kufri Chipsona- 4 (378.78 cm2) recorded the minimum value for leaf area per plant. Maximum dry weight per plant was recorded in variety Kufri Arun (44.96 g) over other varieties. However, the minimum dry weight per plant was recorded in Kufri Chipsona-4(17.65 g). Amongst the varieties, Kufri Arun resulted in higher values of all these characters followed by Kufri Chandramukhi, Kufri Jyoti and Kufri Lauvkar. The differential behavior of potato varieties with respect to morphological characters could be explained solely by the variation in their genetic makeup and adaptability to soil and climatic conditions i.e. (G×E) interaction. Kumar (2011) and Patel *et al.* (2013) also reported the significant differences in the morphological traits that were positively correlated with the genotypes.

Table 1: Morphological characters and Growth analysis parameters of different potato varieties

Varities	Plant height (cm) 75 DAP	Diameter of stem (cm) 75 DAP	Leaves per plant 75 DAP	Leaf length (cm) 75 DAP	Leaf width (cm) 75 DAP	Leaf area plant (cm2) 75 DAP	Dry weight per plant (g) 75 DAP	Leaf area index 60-75 DAP	NAR (g/cm2 /day) 60-75 DAP	CGR (g/plant/ day) 60-75 DAP
Kufri Chipsona-1	58.46	3.82	17.72	5.48	3.82	410.8	30.84	0.32	0.005	0.063
Kufri Chipsona- 2	43.50	3.90	18.82	5.42	3.93	397.9	21.33	0.34	0.004	0.042
Kufri Chipsona- 3	56.51	3.92	16.52	5.44	3.80	382.7	20.42	0.30	0.004	0.051
Kufri Chipsona-4	45.10	3.05	15.06	5.06	3.75	378.7	17.65	0.29	0.002	0.032
Kufri Chandramukhi	62.18	4.03	19.13	5.88	4.62	482.7	42.20	0.38	0.008	0.130
Kufri Arun	63.92	4.09	20.11	5.96	4.70	497.2	44.96	0.43	0.009	0.132
Kufri Lauvkar	59.12	3.96	17.99	5.47	4.45	430.1	33.78	0.35	0.006	0.099
Kufri Surya	58.91	3.86	16.82	5.37	4.48	386.8	27.67	0.34	0.006	0.084
Kufri Jawahar	53.53	3.78	17.41	5.39	4.21	394.3	31.52	0.34	0.005	0.091
Kufri Jyoti	61.45	4.01	18.37	5.85	4.52	430.4	40.36	0.36	0.007	0.113
SEm±	2.40	0.05	0.63	0.13	0.22	10.84	0.033	0.017	0.00062	0.006
C.D. (P=0.05)	7.15	0.16	1.89	0.40	0.68	32.23	0.099	0.052	0.0019	0.018

Growth analysis parameters

Variety Kufri Arun recorded significantly maximum leaf area index as compared to other varieties. However, minimum leaf area index was observed in (0.435) Kufri Chipsona- 4(0.289). The leaf area and leaf area index (LAI) increased up to 75 DAP and decreased thereafter due to senescence and ageing of leaves. In general, the varieties showed a profound effect over these parameters and significant differences were noticed among the varieties at all the growth stages. However, Kufri Arun recorded significantly higher leaf area and LAI as compared to other cultivars at all the growth stages. These results are confirmed with the findings of Ahmed *et al.* (2013). The highest NAR was found in Kufri Arun (0.0088 g/cm2/day) followed by Kufri Chandramukhi (0.0078 g/cm2/day) and Kufri Jyoti (0.0069 g/cm2/day). The lowest value of NAR was observed in Kufri Chipsona- 4 (0.002 g/cm2/day). Similarly the highest CGR was observed in Kufri Arun 0.132 g/plant/day followed by Kufri Chandramukhi (0.130 g/plant/day) and lowest value in Kufri Chipsona- 4 (0.0318 g/plant/day).The varietal differences amongst these growth analysis parameters attributed to the variability in the genetic inheritance among the varieties. This has been supported by Patel *et al.* (2000).

Yield attributing characters

Minimum days for maturity (75.0 days) were observed for Kufri Chandramukhi followed by Kufri Lauvkar (80 days) and Kufri Arun (90 days). However, the varieties Kufri Chipsona- 2 and Kufri Jyoti required maximum 120 days for maturity. Relation of days to maturity to yield is positive and significant. Variation in days to maturity was due to the inherent genetic makeup of the variety and due to difference in response to day length and temperature. These findings are in agreement with the findings reported by Ranjbar and Mirzakhan (2012). Significantly maximum number of tubers per plant was recorded in Kufri Arun (12.67) followed by Kufri Chandamukhi (12.60), Kufri Jyoti (12.40) and Kufri Lauvkar (11.86). While Kufri Chipsona-4 (8.69) recorded minimum number of tubers per plant. The probable reason of enhanced tubers per plant may be due to better germination, genetic makeup and environmental interactions. These findings are in agreement with Singh *et al.* (2007) and Kaushik *et al.* (2006).

Table 2: Yield attributing characters and Economics of different potato varieties

Varieties	Days to maturity	Tubers per plant	Total yield of tubers (kg/plot)	Marketable yield of tubers (q ha^{-1})	Net income (Rs ha)	B:C ratio
Kufri Chipsona-1	100.0	10.33	24.81	242.55	159710	1:2.92
Kufri Chipsona- 2	120.0	9.86	22.28	196.88	114040	1:2.37
Kufri Chipsona- 3	100.0	10.13	24.11	223.55	140710	1:2.69
Kufri Chipsona- 4	110.0	8.69	20.11	188	105160	1:2.26
Kufri Chandramukhi	75.0	12.60	25.92	266.66	183820	1:3.21
Kufri Arun	90.0	12.67	26.33	275.33	192490	1:3.32
Kufri Lauvkar	80.0	11.86	25.14	255.22	172380	1:3.08
Kufri Surya	100.0	9.88	23.79	217	134160	1:2.62
Kufri Jawahar	100.0	9.87	22.81	202.44	119600	1:2.44
Kufri Jyoti	120.0	12.40	25.62	261.44	178600	1:3.15
SEm±	2.00	0.41	0.38	4.24		
C.D. at 5% level	5.96	1.22	1.13	12.68		

Variety Kufri Arun recorded significantly maximum (26.33 kg) yield of tubers per plot followed by Kufri Chandramukhi (25.92kg), Kufri Jyoti (25.62kg), Kufri Lauvkar (25.14kg) and Kufri Chipsona-1(24.81kg). While, the lowest yield of tubers per plot was noted in variety Kufri Chipsona- 4 (20.11 kg). Significantly maximum (24.78, kg per plot and 2735.33, q ha^{-1}) marketable tuber yields were recorded in Kufri Arun followed by Kufri Chandramukhi (24.00 kg per plot, 266.66 q ha^{-1}). However, the lowest marketable tuber yield was observed in Kufri Chipsona- 4 (916.92 kg per plot and 188 q ha^{-1}). The higher yield attributes in Kufri Arun may be owing to maximum increase in growth parameters as well as growth analysis parameters. The present findings on varietal differences are in consequence with those of Alam *et al.* (2003), Ullah and Saikia (2008), Rashid *et al.* (2008), Ummyiah *et al.* (2010) and Ahmad *et al.* (2013).

Economics

Amongst the potato varieties, Kufri Arun brought about the maximum net income (`.1,92,490/ha) with B:C ratio (3.32). This was followed by Kufri Chandramukhi and Kufri Jyoti. The lowest net income (`. 1,05,160/ha and B:C ratio (2.26) were obtained from Kufri Chipsona- 4 variety. The net economical gain was secured in accordance with the per hectare yield of the varieties and thereby gross income. Similar findings were reported by Hosea *et al.* (2012).

REFERENCES

Ahmad, A.; Pal, M; Khetarpal, S. and Pandey, S. K. (2013) Impact of elevated atmospheric CO_2 concentration on growth and yield of potato cultivars. *World Applied Sciences Journal*. **24** (4): 429-435.

Alam, M.K.,; Zaman, M.M.; Nazrul, M.I.; Alam, M.S. and Hossain, M.M.(2003) Performance of Some Exotic Potato Varieties under Bangladesh Condition. *Asian Journal of Plant Science* **2** (1): 108-112.

Hosea, M. and Reuben M. J. Kadigi (2012) Round potato (*Solanum tuberosum*) profitability and implications for variety selections in the Southern Highlands of Tanzania. *Journal of Development and Agricultural Economics* **4** (9), pp. 258-267,

Kaushik, S. K.; Bhardwaj V.; Joseph, T. A.; Gupta, V. K.; Singh, P. H.; Khurana, S. M. P.; Singh, B. P.; Singh, S. V.; Pandey, S. K.; Brajesh Singh and Sharma, Y. K. (2006) Stability of potato genotypes for yield, late blight resistance and their storage behaviour. *Indian Journal of Agricultural Sciences* **76** (1): 26-28.

Kanaujia, S. P. and Manjai Phom (2016) Performance of various genotypes of tomato under foothill conditions of Nagaland. *Annals of Plant and Soil Research* **18** (1): 33-36.

Kumar, S. (2011) Stability analysis in potato (*Solanum tuberosum* L.) for yield and quality traits. *Annals of Biology* **27** (2): 147-151.

Patel, J. C.; Patel, L. R.; Amin, A. U. and Patel, J. K. (2000) Effect of irrigation and nitrogen levels on growth and yield of potato. *Journal of the Indian Potato Association* **27** (1/2): 51-53.

Patel, A. K.; Patel, N. H.; Gami, R. A.; Patel, C. R. and Chauhan, R. M. (2013) Assessment of potato (*Solanum tuberosum* L) hybrids-varieties for table purpose among yield and quality traits. *Trends in Biosciences* **6** (5): 669-673.

Qasim, M.; Khalid, S.; Naz, A.; Khan, M. Z. and Khan, S. A. (2013) Effect of different planting system on yield of potato crop in Kaghan Valley: A mountainous region of Pakistan. *Agricultural Science* **4** (4): 175-179.

Ranjbar M. and Mirzakhan M. (2012) Response of agronomic and morphologic characteristics of commercial and conventional potato cultivars to green house condition*, International Journal of Agriculture and Crop Sciences* 4**-6**/333-335.

Rashid M.H.; Hossain M.M.; Hossain M.; Mahmud A.A.; Akhtar M.I.; Kadian, M.S.; Chujoy E.; Bonierbale M. and Ilangantileke S. Saikat: A new potato variety for coastal areas of Bangladesh. *Potato J*. **35** (1 - 2): 9-11, 2008.

Singh V.; Kumar, D.; Singh R.P.; Singh B.P. and Singh S. (2007) Performance of microtubers of various potato cultivars in net house. *Potato Journal* **34** (1-2): 133-134.

Ullah, Z. and Saikia M. (2008) Yield performance of processing potato varieties in the plains of Assam. Global Potato Conference, 9-12 Des, 2008, New Delhi, pp. 22. Watson, D. J. (1952) The physiological basis of variation in yield. *Advanced of Agronomy* **4**: 101-146.

Ummyiah, H. M.; Khan, S. H.; Wani, K. P.; Hussain, K. and Junaif, N. (2010). Genetic variability in potato (*Solanum tuberosum* L.). *Asian Journal of Horticulture* **5** (1): 61-63.