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Interaction Effect of Varieties and Sowing Dates on Growth and Quality of Radish in Southern Agro Climatic Zone of Andhra Pradesh

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ABSTRACT

The field experiment was conducted to study the "Interaction effect of varieties and sowing dates on growth and quality of radish in southern agro climatic zone of Andhra Pradesh" was carried out during kharif season of 2014-15 at Horticulture College and Research Institute, Dr. Y.S.R. Horticultural University, Anantharajupet, Y.S.R. District of Andhra Pradesh. The experiment was laid out in factorial randomized block design with four varieties of radish viz., Local variety, ArkaNishant, Japanese White and Pusa Chetki and four sowing dates viz., second fortnight of July, first fortnight of August, second fortnight of August and first fortnight of September. Maximum germination percentage (98.33%), plant height (24.98 cm at 30 DAS and 60.54 cm at harvest) and shoot weight (211.14 g) was obtained with Japanese White sown during first fortnight of September (V_3S_4), while in Arka Nishant maximum number of leaves plant^{-1} (36.90), leaf length (36.90 cm) and leaf area (245.33 cm^2) were recorded with first fortnight of September (V_2S_4) sowing.

Key words: *Varieties, Sowing dates, Radish, Growth and Yield*

INTRODUCTION

Radish (*Raphanus sativus* L.) is one of the most important edible and nutritious root vegetable. It is predominantly a cool season vegetable, belongs to the family cruciferae. Asiatic types can tolerate higher temperatures than European varieties. In India, radish is cultivated in an area of 211 m ha with annual production of 3074 MT (NHB 2017-18 3rd estimates). It is a good source of vitamin C (ascorbic acid 15-40 mg/100 g) and minerals like calcium, potassium and phosphorus and vitamin C content is high in early varieties. The characteristic pungent flavour in radish is due to the presence of volatile isothiocyanates (4-methy thio-3-butenyl isothiocyanate), which is high in leaves of all cultivars[1], the seeds are said to be peptic, expectorant, diuretic and carminative[6].

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A salt extracted from roots, dried and burnt to white ash is said to be in stomach trouble. Roots are also rich in carbohydrates and proteins[3]. and have got refreshing and diuretic properties.

Interaction of superior varieties and sowing dates are the most important factor in achieving economic yield[14]. Andhra Pradesh has the favourable climatic conditions for growing radish, for various purposes, but there is limited information regarding the appropriate sowing date and variety suitable for the southern zone. Therefore, the present investigation was under taken to find out optimum time of sowing and variety for better growth of radish.

MATERIAL AND METHODS

A field experiment was conducted at College of Horticulture, Anantharajupet during the *kharif* season 2014. The experimental site had red sandy loam with pH 7.5, EC 0.23 (dSm^{-1}), 144.2, 12.3 and 262.08 kg of N, P2O5 and K2O per ha, respectively. The experiment was laid out in a factorial randomized block design with three replications having sixteen treatments. The treatments comprised of the combination of four varieties with four dates of sowing. The seeds are sown on ridges at a depth of 1.5 cm. Thinning was done at 25-30 DAS by retaining one seedling per hill. The crop was nourished with 80 kg/ha of nitrogen, 60 kg/ha and 80 kg/ha of P2O5 and K2O. Full P2O5, K2O and half nitrogen were applied as a basal and remaining half dose of nitrogen was applied at early root formation stage. The other cultural and plant protection operations were carried out as and when required.Five plants were taken randomly from each experimental plot at different intervals. The growth parameters like Germination percentage (%), number of leaves per plant, plant height (cm) in 30 DAS and at harvest, leaf length (cm), leaf width (cm) and leaf area (cm^2) was recorded. Similarly, the root quality in terms of ascorbic acid, TSS and moisture content were also recorded. The analysis of data was done by the method of variance outlined by Panse and Sukhatme.

Table 1: Interaction effect of varieties and sowing dates on growth parameters of radish

Cultivar X Dates of sowing	Germination percentage (%)	Number of leaves per plant	Plant height (cm)		Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)
			30 DAS	At harvest			
V_1S_1	57.00	20.13	10.82	35.59	20.13	7.97	126.59
V_1S_2	74.67	16.45	11.71	38.92	16.45	8.43	121.76
V_1S_3	84.67	22.97	11.81	40.77	22.97	8.27	107.24
V_1S_4	95.67	22.71	13.22	43.91	22.71	10.37	134.96
V_2S_1	66.67	23.60	14.93	42.46	23.60	10.14	196.77
V_2S_2	79.00	23.17	14.83	44.19	23.17	9.77	214.84
V_2S_3	92.00	30.93	14.70	54.00	30.93	11.95	230.10
V_2S_4	97.00	36.90	16.73	53.34	37.90	14.26	245.33
V_3S_1	85.00	21.17	16.65	43.46	21.17	9.10	157.49
V_3S_2	86.00	21.71	17.10	42.85	21.71	9.21	179.35
V_3S_3	96.00	24.71	21.15	52.28	24.71	11.27	219.29
V_3S_4	98.33	30.93	24.98	60.54	30.93	11.65	223.26
V_4S_1	64.67	18.54	11.72	32.45	18.54	7.49	112.87
V_4S_2	76.33	20.35	13.30	31.09	20.35	7.89	109.05
V_4S_3	87.33	19.12	13.63	31.98	19.12	8.82	106.24
V_4S_4	94.67	26.84	15.06	41.31	27.84	9.47	105.32
S.Em±	1.65	1.54	0.68	1.68	1.48	0.61	5.75
CD at 5%	4.77	4.44	1.96	4.85	4.28	NS	16.62

RESULTS AND DISCUSSION

Growth parameters: The interaction between cultivars and sowing dates exhibited significant difference with respect to all the growth parameters except leaf area (cm^2).

Germination percentage (%):

Highest germination percentage (98.33%) was recorded with Japanese white sown on first fortnight of September (V_3S_4) followed by Arka Nishanth ((97.00) sown on first fortnight of September (V_2S_4), Japanese white (96.00) sown on Second fortnight of August (V_3S_3). The minimum germination percentage (57.00) was recorded in local variety sown on second fortnight of July (V_1S_1).

Radish is a quick growing cool season root vegetable. The optimum temperature for germination is 30^0C. The gradual increase in germination percentage from second fortnight of July to first fortnight of September might be due to gradual decrease in temperatures from early sowing (32-34^0C) to late sowing (25-28^0C) which decreases the soil temperature and increases the moisture content in soil. These findings are in agreement with the reports of Malek *et al*.[7], in carrot.

Number of leaves per plant

The interaction effect of cultivars and dates of sowing on number of leaves per plant differed significantly. Maximum number of leaves per plant (36.90) was recorded with Arka Nishant sown on first fortnight of September (V_2S_4), whereas minimum number of leaves per plant (16.45) was noticed with Local variety at first fortnight of August (V_1S_2) and it was inferior to all other combinations.

The number of leaves per plant increased from July second fortnight to September first fortnight sowing which might be due to optimum temperatures that prevailed during vegetative growth period which resulted in greater photosynthetic activity and higher mobilization of assimilates. Higher production of leaves per plant at ambient temperatures was also reported by Saikia *et al*.[12], in broccoli.

Plant height (cm)

Interaction effect between varieties and time of sowing with respect to plant height at 30 DAS and at harvest was found be significant. Japanese white recorded maximum plant height (24.98 cm at 30 DAS and 60.54 cm at harvest) with first fortnight of September (V_3S_4) followed by Japanese white (21.15 cm at 30 DAS) and Arka Nishant (54.00 cm at harvest) sown on second fortnight of August (V_3S_3, V_2S_3). Whereas, Pusa Chetki recorded minimum plant height (10.82 cm at 30 DAS and 31.09 cm at harvest) with second fortnight of July (V_4S_1).

All environmental factors especially temperature support the plant height[4]. The gradual increase in plant height from July to September might be due to higher temperature (31.1^0C) prevailed during early growth phase and lower temperature (25^0C) favourable growing period for late sown crop. These results are in conformity with the findings of Choudhary and Ramphal[2], and Vogal and Paschold[15], in cauliflower.

Leaf length (cm)

Interaction effects due to varieties and sowing date were found significant on leaf length in radish. The highest leaf length (36.90 cm) was recorded by Arka Nishant sown on first fortnight of September (V_2S_4), whereas, the lowest leaf length (16.45 cm) was recorded with Local variety sown on first fortnight of August (V_1S_2).

In general, leaf length is a varietal character, but also affected by external factors. The variation in leaf length of radish varieties with different sowing dates observed in the present study is due to their genetic constitution and to some extent by environmental factors. These findings are in agreement with the reports of Nasr and Abd EI-Razek, in sugar beet.

Leaf Area (cm^2)

The interaction effect between varieties and sowing dates of radish was significant with regard to leaf area. Maximum leaf area (245.33 cm^2) was obtained with Arka Nishant sown during first fortnight of September (V_2S_4) which was statistically on par with Arka Nishant (230.10 cm^2) sown during second fortnight of August (V_2S_3). The minimum leaf area (105.32 cm^2) was produced

by Pusa Chetki sown during first fortnight of September (V_4S_4).

Leaf area has gradually increased with second fortnight of July to first fortnight of September which might be due to late planting that allows for early development of an optimal leaf surface, when the environment is most suitable for maximum assimilation of energy and subsequent transfer of photosynthate to the storage root. Similar results were also elucidated by Karbalaei *et al*.[5], in sugar beet.

Shoot weight (g)

The interaction effects due to varieties and sowing dates found to be significant. Maximum Shoot weight (211.14 g) was obtained with the variety, Japanese white sown during first fortnight of September (V_3S_4) which was on par with Arka Nishant (171.89 g) sown on first fortnight of September (V_2S_4). The variety, Pusa Chetki sown during first fortnight of August (V_4S_2) recorded minimum shoot weight (34.12 g).

Highest shoot weight during first fortnight of September might be due to low temperature and short day length associated with cloudy days which is responsible for profuse vegetative growth. These findings are in agreement with Panwar *et al*[11]. Lowest shoot weight during early sowings due to highest temperature (31.8^0C) during early growth period reduces the shoot growth of radish.

Table 2: Interaction effect of varieties and sowing dates on quality parameters of radish

Cultivar X Dates of sowing	TSS (^{0}Brix)	Ascorbic acid (mg/100g)	Moisture content (%)
V_1S_1	3.53	20.62	91.77
V_1S_2	3.09	23.61	93.22
V_1S_3	3.37	22.97	92.08
V_1S_4	2.84	17.82	92.01
V_2S_1	3.19	18.05	92.56
V_2S_2	3.09	21.13	91.93
V_2S_3	4.11	18.63	91.94
V_2S_4	2.43	13.77	92.00
V_3S_1	3.38	21.99	91.01
V_3S_2	3.50	16.55	88.00
V_3S_3	2.87	17.50	93.40
V_3S_4	2.11	16.57	92.37
V_4S_1	3.46	11.86	92.06
V_4S_2	3.43	10.57	91.73
V_4S_3	2.89	10.19	92.02
V_4S_4	2.75	8.50	92.35
S.Em±	0.21	0.31	1.25
CD at 5%	0.60	0.90	NS

Quality parameters

The interaction between cultivars and sowing dates exhibited significant difference with respect to the quality parameters *viz*., TSS and ascorbic acid content except moisture content (%).

TSS (^{0}Brix)

The interaction between varieties and sowing dates of radish was significant with regard to TSS. Maximum TSS (4.11 ^{0}Brix) was recorded in Arka Nishant sown during second fortnight of August (V_2S_3) which was on par with (V_1S_1) Local variety sown on second fortnight of July (3.53 ^{0}Brix). The minimum TSS (2.11 ^{0}Brix) was recorded in Japanese white sown on first fortnight of September (V_3S_4).

The variation in TSS might be due to genetic make-up of varieties and weather factors to which plants were exposed, and such

kind of genetic differences for root and other quality characters in different radish genotypes had also reported by Sharma and Chadha[13] and Panwar *et al*[11].

Ascorbic acid (mg 100 g^{-1})

Interaction effects due to varieties and sowing date were found significant on ascorbic acid content in radish roots. Highest ascorbic acid content (23.61 mg 100 g^{-1}) was recorded by Local variety sown during first fortnight of August (V_1S_2) which was statistically on par with Local variety (22.97 mg 100 g^{-1}) sown on second fortnight of August (V_1S_2). The lowest ascorbic acid content (8.50 mg 100 g^{-1}) was recorded with Pusa Chetki sown during first fortnight of September (V_4S_4).

Moisture content (%)

The data pertaining to moisture content of radish was found to be not significant with respect to varieties, sowing dates and interaction effects.

CONCLUSIONS

Based on the results of the study, it was concluded that radish varieties, Japanese White and Arka Nishant were sown during second fortnight of August and first fort night of September were best suited for growing in southern agro climatic zone of Andhra Pradesh.

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