Visit us - www.researchjournal.co.in ■ DOI : 10.15740/HAS/IRJAES/8.1/51-55
International Research Journal of Agricultural Economics and Statistics
Volume 8 | Issue 1 | March, 2017 | 51-55 ■ e ISSN-2231-6434

Research Paper

Effect of plant spacing on marketable yield of table beet (*Beta vulgaris* L.)

■ **ANJALI M. GAHARWAR AND JAYASHRI D. UGHADE**

See end of the paper for authors' affiliations

Correspondence to :
JAYASHRI D. UGHADE
Vasantrao Naik College of Agricultural Biotechnology (Dr. PDKV), YAVATMAL (M.S.) INDIA

Paper History **:**
Received : *23.09.2016;*
Revised : *14.01.2017;*
Accepted : *23.01.2017*

ABSTRACT : A field experiment to standardize package of practices for beet root cultivation in Vidarbha region and to find out optimum spacing for higher yield of marketable beet root during the winter seasons of three consecutive years was undertaken. The experiment was conducted in a Randomized Block Design at the farm of Agricultural Research Station (Dr. PDKV), Yavatmal. On the basis of spacing, plants were transplanted at two row spacing *viz.*, 30cm and 45 cm and in row three plant to plant spacing *viz.*, 10cm, 20cm and 30cm with one separate 45 cm x 45 cm wider spacing plot with three replications. The result indicated that different plant spacing had significantly influenced on shoot fresh weight, beet root fresh weight, diameter of beet root and marketable yield of beet root. Spacings have significant effect on marketable yield of beet root in the three seasons of experimentations. However, TSS content of beet root was in significantly influenced with different plant spacing. Beet root sown at closer planting distance 30 cm x 10 cm gave significantly higher marketable root yield but fresh weight of beet root was significantly greater under wider plant spacing.

KEY WORDS : Plant spacing, Yield, *Beta vulgaris*, Root diameter, Fresh weight, TSS

HOW TO CITE THIS PAPER : Gaharwar, Anjali M. and Ughade, Jayashri D. (2017). Effect of plant spacing on marketable yield of table beet (*Beta vulgaris* L.). *Internat. Res. J. Agric. Eco. & Stat.*, **8** (1) : 51-55, **DOI : 10.15740/HAS/IRJAES/8.1/51-55.**

INTRODUCTION :

Beet root (*Beta vulgaris* L.) belongs to the family *Chenopodiaceae*, is a commercial crop for production point. Beet root grows in cool weather on any type of well drained soil. Beets are one of the few vegetables whose roots and tops are both consumed as food. Beets are a good source of folate, manganese, sodium, and potassium. They also provide vitamin C, magnesium, iron, copper and phosphorus. The recent interest of people in beet root cultivation increases worldwide has been primarily driven by the discovery that sources of dietary nitrate may have important implications for managing cardio-vascular health (Lundberg *et al.*, 2008). It has provided compelling evidence that beetroot ingestion offers beneficial physiological effects that may translate to improved clinical outcomes for several pathologies, such as; hypertension, atherosclerosis, type 2 diabetes and dementia (Vanhatalo *et al.*, 2010 and Ninfali and Angelino, 2013). Besides that it required minimum cost of cultivation as it required little weeding due to dense foliage enough to keep the most weeds at bay and less attacked by pest and diseases.

Even though cultivation of beet root remains neglected by the farming community of the leading vegetable producing country of the world like India which

present cultivation occupies an area of 6.09 million hectares with an annual production of 84.8 million tonnes accounting to a productivity of 13.90 tonnes/ha (The Hindu Survey of Indian Agriculture, 2004). It happens due to one or more reasons and the major one is lack of awareness about scientific production as well as cultivation technology for beet root production under varying climatic condition is still not recommended. So the crop having very minimum cost of cultivation which gives bumper production with higher market value *i.e.* beet root remains neglected. Hence, to standardize package of practices for beet root cultivation in Vidarbha region an experiment to find out optimum spacing for higher yield of marketable beet root was undertaken.

MATERIALS AND METHODS :

A field experiment was conducted for three consecutive winter seasons of December, 2009, 2010 and 2011 in the farm of Agriculture Research Station, Yavatmal (MH). The soil of the experimental plot was vertisole soil with pH 7.32 – 7.89, available N, P_2O_5 and K_2O content was 265.20 kg/ha, 24.2 kg/ha and 295 kg/ha, respectively. The experiment was laid out in Randomized Block Design with seven treatments with three replications. The variety BJ beet was used for the experiment and sown at various spacing *viz.*, 30 cm x10 cm, 30cm x 20 cm, 30 cm x 30 cm, 45 cm x 10 cm, 45 cm x 20 cm, 45 cm x 30 cm and 45 cm x 45 cm.

All recommended agronomic practices *i.e.* disc ploughing, two harrowing, levelling and formation of ridges and furrows were followed for beet root sowing. Sowing was done on the shoulders of ridges manually. A basal dose of 40 kg N, 40 kg P_2O_5 was applied in furrows through single super phosphate and urea followed by top dressing of 40 kg N 30 days after sowing. Irrigation was given to the crop as per requirement at 7 to 10 days interval. Manual hand weeding was done four weeks after sowing during the three seasons.

Observations were recorded when plants showed signs of maturity, which is indicated by leaf yellowing and partial drying of lower leaves by randomly uprooting five plants per inner two ridges of plot to determine fresh weight of shoot and beet root. Simultaneously observations on beet root diameter, marketable yield per plot and yield per hector were undertaken. Statistical analysis was applied appropriate for the Randomized Block Design (Gomez and Gomez, 1984). For the analysis the grades were followed to categorize the marketable yield of beet root as proposed by Julie *et al.* (2010). As per this study only size 2 roots were considered marketable. Size 0 and size 1 are undersize however, size 3 was considered oversized. The proposed scale is as follows

Size 0 <3/4 inches in diameter
Size 1 1.87cm-4.05cm or ¾ to 1 5/8 inch in diameter
Size 2 4.05 to 6.25 cm or 1 5/8-2 ½ inch in diameter
Size 3 >6.25 cm or 2 ½ inches in diameter

RESULTS AND DATA ANALYSIS :

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Fresh weight of shoot and beet root :

Effect of plant spacings on fresh weight of shoot and beet root is illustrated in Table 1. Shoot fresh weight was recorded significantly greater in the treatment where plants spaced at wide planting distances. Greater fresh weight of shoot (146.45 g) was recorded with plant spacing 45x45 cm followed by 45x30 cm (142.62 g) and 30x20 cm (132.71 g), which was on par with each other. Significantly highest fresh weight of beet root was recorded in the treatment 45 cm x 45 cm plant spacing *i.e.* 204.77 g followed by 45x30 cm plant spacing *i.e.* 199.75 g. The fresh weight of beet root was found greater in less density population in wider spacings as compared to high dense plants in closer spacings.

These findings are in the conformity of Kogali *et al.* (2012) who reported that, wider spacing of 25 cm recorded the highest root fresh weight in the second season of field trial during the experimental trail of two seasons where row width of 70 cm kept constant for all treatments. Further, Hassanin and Ramadan (1999) also reported that, 30 cm hill spacing increased root dry weight over 20 cm hill spacing. The significant effect in fresh weight of shoot and root due to in row plant spacings and nor due to row width of plants, means higher the planting density lesser the size of roots. Root dry weight and fresh weight was influenced significantly when sown at in row wider spacing of 25 cm (Julie *et al.*, 2010).

Diameter of beet root :

The data presented in Table 1 indicated that, various plant spacings significantly influenced the beet root

diameter. The maximum beet root diameter 7.46 cm were recorded in the treatment where plants spaced at 45 cm x 45 cm distance. Other wider spaced plant treatments 45 cm x 20 cm, 45 cm x 30 cm, 30 cm x 20 cm and 30 cm x30 cm were found on par with each other. These results are matching with the findings of Kogali *et al.* (2012) who recorded wider spacing in row *i.e.* 25 cm resulted in greater root diameter with that 20 cm in row spacing which was at par with in row spacing of 25 cm than 15 cm in row spacing. The wider spacing (35 cm between hills) gave more space to roots to grow horizontally and its roots diameter was bigger than 15 cm hill distance as reported by Basal *et al.* (2002) working on fodder beet.

TSS content in beet root :

Plant spacings had not recorded any effect on TSS content in table beet root (Table 2). However, it was observed that, TSS content varies with harvesting time of beet root and soil moisture availability in soil.

Beet root yield :

Yield of beet root was significantly influenced by different plant spacing because wider the plant spacing provides more space to root growth hence, obtained the bigger sized and weighted yield of roots but due to less plant density the average yield ha^{-1} was low. However, in closer spacing as accumulated more number of plants per unit area due to high density, obtained higher yield of roots. Maximum yield of marketable size of beet roots (29.30 t ha^{-1}) was obtained in the treatment 30 cm x10 cm followed by the treatment 30 cm x 20 cm spacing *i.e.* 27.83 t ha^{-1}. Lowest production of beet root was recorded in the treatment of wider spacing *i.e.* 45 cm x 45 cm (10.75 t ha^{-1}).

Table 1 : Effect of spacing on fresh weight of shoot and beet root and diameter of beet root

Sr. No.	Treatments	Fresh weight of beet root plant (g)			Pooled mean	Weight of beet root (g)			Pooled mean	Diameter of beet root (g)			Pooled mean
		2009-10	2010-11	2011-12		2009-10	2010-11	2011-12		2009-10	2010-11	2011-12	
1.	30 x 10 cm	120.81	113.07	119.61	98.80	67.22	115.29	96.25	92.92	4.57	5.30	5.80	5.22
2.	30 x 20 cm	150.85	137.71	136.49	125.78	137.94	240.26	146.64	174.95	7.20	7.00	6.66	6.95
3.	30 x 30 cm	131.53	124.06	122.40	118.26	99.86	211.60	212.46	174.64	6.87	6.80	5.25	6.31
4.	45 x 10 cm	122.20	123.04	126.73	120.20	88.15	225.40	138.46	150.67	5.12	6.50	5.20	5.61
5.	45 x 20 cm	135.59	138.54	143.50	136.52	101.49	243.65	202.66	182.60	6.87	7.37	7.26	7.17
6.	45 x 30 cm	139.23	142.62	150.28	138.34	140.73	250.50	208.02	199.75	7.32	7.30	6.85	7.16
7.	45 x 45 cm	143.16	146.45	155.60	140.60	145.29	258.40	210.62	204.77	7.57	7.50	7.30	7.46
	F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. ±	6.09	2.99	3.92	7.28	6.54	12.77	12.11	16.99	0.67	0.41	0.43	0.37
	CD ±	18.78	9.23	5.54	22.42	20.14	39.35	37.32	52.34	2.07	1.28	1.33	1.31
	CV	7.83	6.79	12.08	10.04	10.15	10.02	9.87	14.25	17.94	10.53	9.67	7.92

Table 2 : Effect of spacing on TSS content and marketable yield of beet root ha^{-1}

Sr. No.	Treatments	TSS content in beetroot (%)			Pooled mean	Yield t ha^{-1}			Pooled mean
		2009-10	2010-11	2011-12		2009-10	2010-11	2011-12	
1.	30 x 10 cm	14.77 (22.63)	14.75 (22.63)	14.10 (22.25)	14.66 (22.51)	22.69	37.26	27.97	29.30
2.	30 x 20 cm	14.57 (22.46)	14.55 (22.46)	14.34 (22.04)	14.43 (22.32)	22.44	36.77	24.29	27.83
3.	30 x 30 cm	13.97 (21.97)	13.98 (21.97)	13.78 (21.68)	13.83 (21.83)	13.22	23.52	26.55	21.10
4.	45 x 10 cm	14.45 (22.38)	14.46 (22.38)	14.45 (21.79)	14.25 (22.18)	20.47	19.17	14.92	18.19
5.	45 x 20 cm	13.85 (21.89)	13.86 (21.89)	13.65 (21.59)	13.61 (21.65)	11.06	22.83	19.16	17.68
6.	45 x 30 cm	13.20 (21.30)	13.19 (21.30)	13.20 (21.30)	13.18 (21.29)	10.88	19.63	14.86	15.12
7.	45 x 45 cm	13.62 (21.64)	13.62 (21.64)	13.43 (22.34)	13.65 (21.68)	8.40	13.83	10.04	10.75
	F test	NS	NS	NS	NS	Sig.	Sig.	Sig.	Sig.
	S.E. ±	0.4	0.60	0.27	0.16	1.25	1.94	1.45	1.95
	CD ±	1.22	1.81	0.84	0.51	3.84	5.99	4.47	5.99
	CV	--	--	--	--	11.31	11.13	10.43	13.79

NS=Non-significant

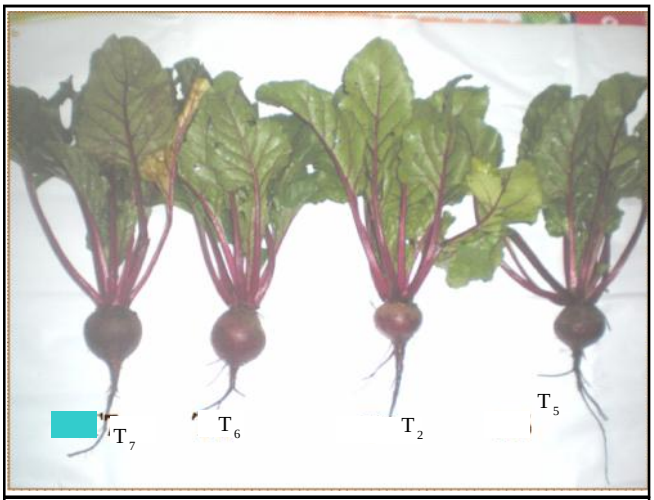

Fig. 1 : Difference of beet root diameter in different treatments of plant spacings

Fig. 3 : Beet root diameter in wider spaced plantation

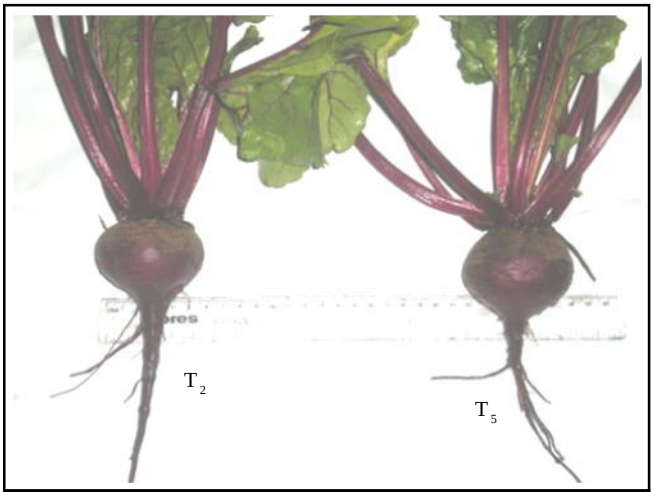

Fig. 2: Beet root diameter in closed spaced plantation

Fig. 4: Experimental plot view

Similar observations were also made by Benjamin and Bell *et al.* (1985); Mack (1968) and Tyler *et al.* (1982) who stated that, higher the plant densities within the rows increases the proportion of plants with small roots, usually at the expenses of total beet yield.

Conclusion :

Different plant spacing had significantly influenced on shoot fresh weight, beet root fresh weight, diameter of beet root and marketable yield of beet root. However, TSS content of beet root was insignificantly influenced with different plant spacing. Hence, it is recommended to plant beet root at 30x10 cm spacing to get greater marketable beet root yield.

The present results are indicative of the potential success of table beet root as a winter crop in India. As the cultural practices can influence the performance and success of beet root production, further trials on different sowing time, harvesting date, different layouts are required to study.

Acknowledgement :

We acknowledge with great gratitude the Agriculture Research station, Yavatmal for allotting the facilities to conduct the field experimental trail on their farm.

Authors' affiliations:
ANJALI M. GAHARWAR, Krishi Vigyan Kendra (Dr. PDKV), YAVATMAL (M.S.) INDIA

LITERATURE CITED :

Basal, S.A.A., Zohry, A.A. and Farghaly, B.S. (2002). Effect of tillage systems, hill spaces and potassium levels on growth and productivity of fodder beet. *Zagazing J. Agric. Res.*, **29** (5): 1379-1393.

Benjamin, L.R. and Bell, N. (1985). The influence of seed type and plant density on variation in plant size of table beets. *J. Agri. Sci. Cambridge*, **104** : 615-624.

Gomez, K.A. and Gomez, A.A. (1984). *Statistical procedures for agricultural research*. 2nd Ed. John Willy and Sons Inc. New York. 680 p.

Hassanin, M.A. and Ramadan, B.H. (1999). Influence of plant densities and distribution on performance of some beet varieties (*B. vulgaris* L.) Bull. *Faculty of Agriculture, Cairo Univ.*, **2** : 315-322

Julie, R. Kikkere, Reiners, Stephen and Gugino, Beth K. (2010). Row width, population density and harvest date effects on marketable yield of table beet. *Hort. Technol.* , **20** (3) : 560-567.

Kogali, M.E., Ibrahim, Y.M. and El Hag M.G. (2012). Effect of nitrogen and spacing on growth of fodder beet [*B. vulgaris* (L.) var. Crassa] cultivars under Sudan conditions. *J. Pharmaceutical & Scientific Innovation*, **1** (3) : 67-71.

Lundberg, J.O., Weitzberg, E. and Gladwin, M.T. (2008). The nitrate-nitrite-nitric oxide pathway in physiology and therapeutics. *Nat. Rev.*, **7** (8) : 156–167.

Mack, H.J. (1968). Spacing affects yield, size of table beets. *Oregon Veg. Dig.*, **17** : 1-4.

Mack, H.J. (1979). Effects of row spacings, fertilizers and harvest dates on table beets. *J. Amer. Soc. Hort.*, **104** : 717-720.

Ninfali, P. and Angelino, D. (2013). Nutritional and functional potential of *Beta vulgaris* cicla and rubra. *Fitoterapia*, **89** : 188–199.

The Hindu Survey of Indian Agriculture, 2004. Pp. 170-173.

Tyler, F.T., Adas, L. and Benjamin L.R. (1982). Spacing red bet for high returns. *Grower*, **97** (25): 19-23.

Vanhatalo, A., Bailey, S.J., Blackwell, J.R., di Menna, F.J., Pavey, T.G., Wilkerson, D.P., Benjamin, N., Winyard, P.G. and Jones, A.M. (2010). Acute and chronic effects of dietary nitrate supplementation on blood pressure and the physiological responses to moderate-intensity and incremental exercise. *Am. J. Physiol. Reg.* I., **299** (4) : 1121–1131.