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Earliness and yield parameters of eggplant (*Solanum melongena* L.) grafts under different spacing and fertigation levels

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Field study was undertaken to standardize spacing and fertigation levels for eggplant (*Solanum melongena* L.) grafts. A strip plot design was adopted with four spacing levels (1 × 1, 2 × 1, 1.5 × 1.5 and 0.6 × 0.6 m) and three fertigation levels: 75, 100 and 125% recommended dose of fertiliser (RDF) replicated four times. After six months, the plants were pruned to obtain the ratoon crop which lasted four months. The days taken for 50% flowering and first harvest were affected by nutrition and neither spacing nor interaction. The 75 and 100% RDF were on par for early flowering (32.00 and 32.38 days in main crop; 16.88 and 17.00 days in ratoon crop); and early harvest (44.38 and 45.44 days in main crop; 34.38 and 35.56 days in ratoon crop). The treatment combination 1 × 1 m + 100% RDF recorded the highest marketable yield of 110.25 and 59.42 t/ha, in main and ratoon crops, respectively. Thus, cultivation of eggplant grafts under 1 × 1 m spacing along with 100% RDF (200:150:100 kg NPK/ha) through drip fertigation is recommended.

Key words: Fertigation, plant density, *Solanum melongena* L., vegetable grafting.

INTRODUCTION

Grafting of eggplant cultivars on perennial and wild *Solanaceous* species was proved to increase yield and availability period of the fruits (Gisbert et al., 2011; Lee, 1994). The use of *Solanum torvum* as rootstock was reported to confer resistance to *Verticillium* wilt, *Fusarium* wilt, bacterial wilt and root knot nematode (King et al., 2008; Sebahattin et al., 2005). Grafting is also high effective in ameliorating crop losses caused by adverse environmental conditions (Schwarz et al., 2010). The use of vegetable grafts will be most successful when complemented with sustainable farming system practices (Kubota, 2006). Among them, plant spacing is an important agronomic attribute since it is believed to have effects on light interception for photosynthesis which is the energy manufacturing medium using green parts of the plant. Also it affects rhizosphere exploitation by the plants (Ibeawuchi et al., 2008). Plant nutrition also plays an important role for enhancing yield of eggplant. Fertilizers applied under traditional methods are generally not utilized efficiently by the crop; while in drip fertigation nutrients are applied directly into the zone of maximum root activity and consequently fertilizer-use efficiency can be improved over conventional method of fertilizer application (Hebbar et al., 2004). However, according to

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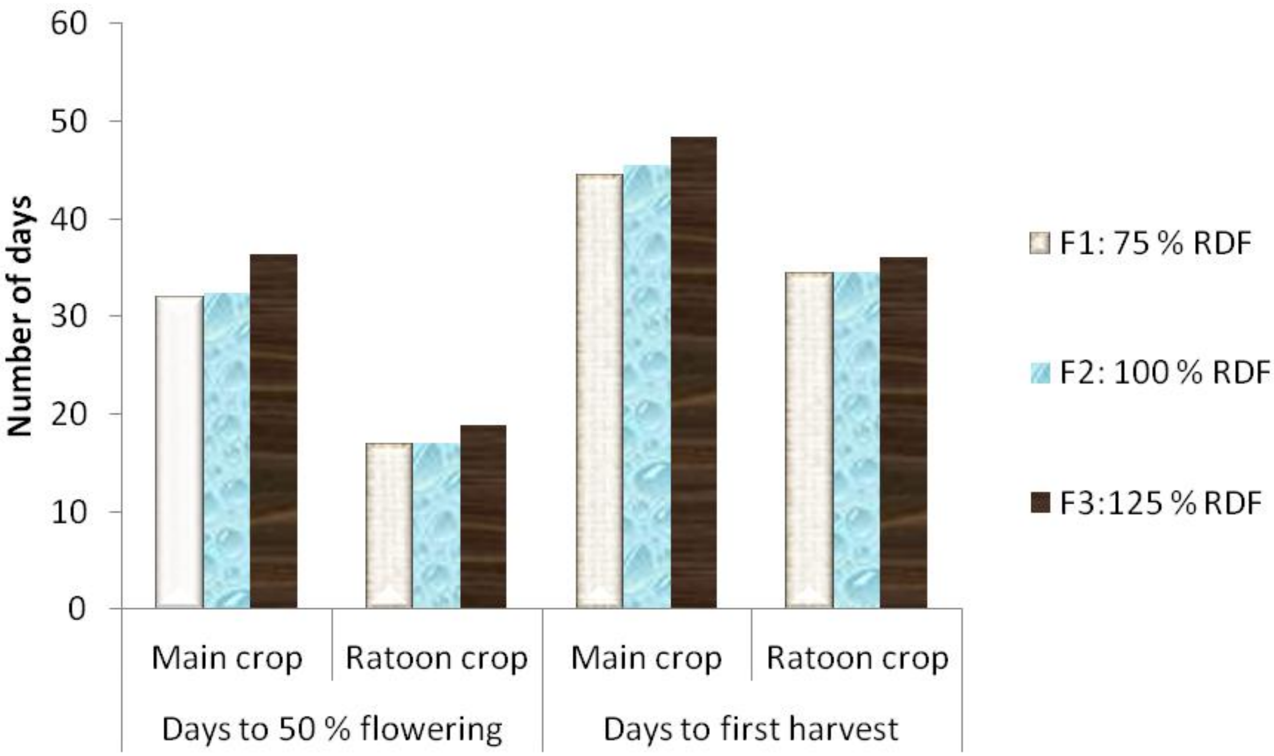

Figure 1. Effect of fertigation levels on days to 50% flowering and first harvest in eggplant grafts.

Colla et al. (2010) and Arao et al. (2008), available information on spacing and nutrition for grafted vegetables is not sufficient for commercial cultivation.

Therefore, the aim of this article is to provide the results of field experiment conducted to find out the effect of spacing and fertigation levels on earliness and yield parameters for eggplant (*Solanum melongena* L.) grafted onto *S. torvum*.

MATERIALS AND METHODS

The experiment was carried out at the University Orchard, Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The study location is situated at 11° North latitude and 77° East longitude and at an elevation of 426.6 m above mean sea level. *S. torvum* was used as rootstock and the scion was eggplant (*S. melongena* L.) F_1 hybrid, COBH 2. A strip plot design was adopted with four levels of spacing (S1: 1 × 1 m, S2: 2 × 1 m, S3: 1.5 × 1.5 m and S4: 0.6 × 0.6 m) and three levels of fertigation (F1: 75% RDF, F2: 100% RDF and F3: 125% RDF) replicated four times. The recommended dose of fertilizer (RDF) adopted was 200:150: 100 kg of N: P: K / ha. Drip lines were laid to cover entire area of the field and planting was done in June 2011 by using forty days old, vigourous and healthy grafts. The 75% of P was given as basal application along with 25 ton ha of farm yard manure while 25% of P was given along with N and K through fertigation in equal splits from third week after planting. Fertilizers applied through fertigation were in the form of NPK 19:19:19, mono ammonium phosphate (12:61:0), potassium nitrate (13:0:45) and urea (46:0:0). Recommended cultural practices were followed. After six months, the plants were pruned to obtain ratoon crop which was maintained for four months. The data were recorded for days to 50% flowering, days to first harvest, fruit weight, number of marketable fruits per plant, marketable yield per plant and marketable yield per hectare.

Analysis of variance was performed for all the recorded data by using *M Stat-C* Software package and the level of significance was set at $p < 0.05$. LSD test was conducted for pair-wise comparisons of means.

RESULTS

Effect of spacing and fertigation levels on days to 50% flowering and first harvest in eggplant grafts

The days taken to 50% flowering were significantly affected by fertigation levels and neither spacing nor interaction. The 75 and 100% RDF were on par for early flowering (32.00 and 32.38 days in main crop; 16.88 and 17.00 days in ratoon crop); and early harvest (44.38 and 45.44 days in main crop; 34.38 and 35.56 days in ratoon crop). Plants receiving 125% RDF recorded the delayed 50% flowering and first harvest in both main and ratoon crops (Figure 1).

Effect of spacing and fertigation levels on yield parameters in eggplant grafts

Spacing, fertigation levels and their interaction significantly

Table 1. Effect of spacing and fertigation on yield parameters in eggplant grafts.

Treatment	Main crop			Ratoon crop		
	Fruit weight (g)	Number of marketable fruits/plant	Marketable yield/plant (kg/plant)	Fruit weight (g)	Number of marketable fruits/plant	Marketable yield/ plant (kg/plant)
Factor A: Spacing (S)						
S1: 1 ×1 m	61.12[c]*	173.24[b]	10.36[c]	60.21[c]	95.85[c]	5.56[c]
S2: 2 × 1 m	64.90[b]	233.31[a]	14.82[b]	62.06[b]	119.88[b]	7.23[b]
S3: 1.5 × 1.5 m	67.44[a]	243.30[a]	16.07[a]	63.71[a]	126.32[a]	7.84[a]
S4: 0.6 × 0.6 m	54.99[d]	48.96[c]	2.71[d]	54.07[d]	33.20[d]	1.58[d]
CD (P = 0.05)	0.49	16.68	1.12	1.03	5.00	0.23
Factor B: Fertigation (F)						
F1: 75% RDF	53.71[c]	163.76[b]	8.87[b]	52.45[c]	89.16[c]	4.58[b]
F2: 100% RDF	62.85[b]	191.43[a]	12.23[a]	61.63[b]	98.79[a]	6.12[a]
F3: 125% RDF	69.79[a]	168.94[b]	11.87[a]	65.96[a]	93.49[b]	6.05[a]
CD (P = 0.05)	0.81	10.05	0.69	1.59	3.92	0.30
Interaction (S × F)						
S1F1	52.11[i]	162.92[e]	8.42[e]	51.21[g]	88.26[h]	4.29[e]
S1F2	62.17[e]	190.50[d]	12.30[d]	61.22[d]	105.83[f]	6.26[d]
S1F3	69.09[c]	166.32[e]	12.38[d]	67.22[ab]	93.45[g]	6.14[d]
S2F1	56.14[g]	217.23[c]	12.09[d]	54.79[f]	115.68[e]	6.11[d]
S2F2	65.74[d]	258.61[a]	17.49[b]	64.84[c]	124.20[bc]	7.83[b]
S2F3	72.82[b]	224.10[bc]	17.398[b]	66.55[b]	119.75[d]	7.74[b]
S3F1	59.06[f]	229.25[b]	13.40[c]	57.16[e]	121.34[cd]	6.71[c]
S3F2	68.90[c]	267.72[a]	18.92[a]	66.75[b]	130.23[a]	8.47[a]
S3F3	74.37[a]	232.93[b]	18.35[a]	68.19[a]	127.41[ab]	8.34[a]
S4F1	47.54[j]	45.64[f]	2.17[g]	46.64[h]	31.34[i]	1.23[g]
S4F2	54.61[h]	48.88[f]	2.67[f]	53.71[f]	34.90[i]	1.66[f]
S4F3	62.83[e]	52.39[f]	3.29[f]	61.86[d]	33.35[i]	1.85[f]
CD (P = 0.05)	0.83	10.00	0.60	1.15	3.81	0.36
Grand mean	62.11	174.71	10.99	60.01	93.81	5.55
CV (%)	0.90	3.85	3.92	1.29	2.73	4.39

*The mean followed by the same letter(s) are not significantly different at p = 0.05.

affected yield parameters namely, fruit weight, number of marketable fruits per plant, marketable fruit yield per plant and per hectare in both main and ratoon crops (Table 1 and Figure 2).

The 1.5 × 1.5 m spaced plants recorded the highest fruit weight (67.44 and 63.71 g) and number of 243.30 and 126.32 fruits/plant in main and ratoon crops, respectively (Table 1). The highest marketable yield (98.47 and 52.84 t/ha) was recorded under 1 × 1 m spacing in main and ratoon crops, respectively (Figure 2). The highest fruit weight (69.79 and 65.96 g) was recorded under highest nutrition level (125% RDF) while the highest number of 191.43 and 98.79 marketable fruits/plant and marketable yield (87.24 and 44.79 t/ha) were observed under 100% RDF in main and ratoon crops, respectively (Table 1 and Figure 2).

DISCUSSION

The spacing levels did not affect significantly the days to 50% flowering and first harvest; the reason could be that, at the initial stage up to the first harvest, there was no competition for space among different spacing levels. Similar results were also recorded by Birbal et al. (1995) in okra and Saglan and Yazgan (1995) in tomato. The delayed flowering and first harvest recorded by the plants fertilised with 125% RDF might have been due to the influence of higher level of nitrogen in delaying initiation of flowering caused by prolonged vegetative phase (Rajangam, 1991). Similar results were found by He and Chen (1996) in tomato and Suthar et al. (2005) in eggplant. In both main and ratoon crops, the 1.5 × 1.5 m spaced plants had the highest fruit weight and number of

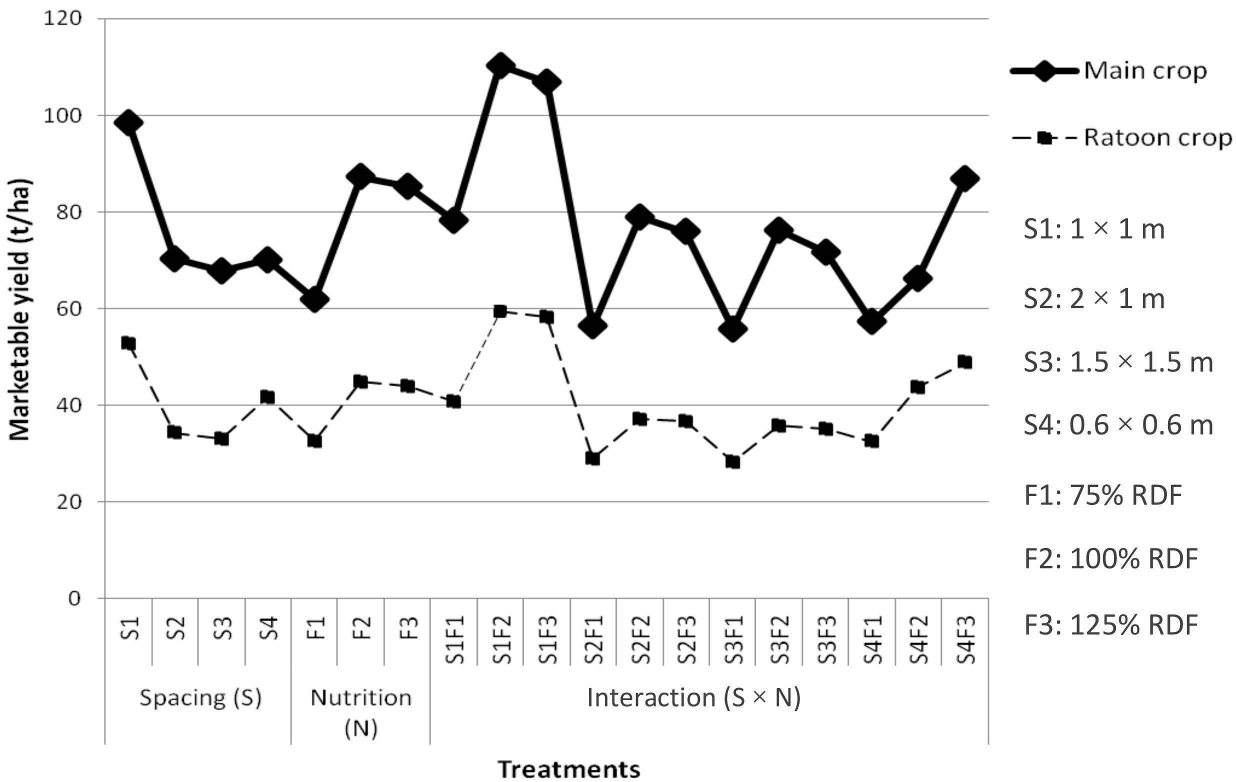

Figure 2. Marketable yield of eggplant grafts as affected by spacing and fertigation.

fruits per plant. Since these widest spaced plants had lowest competition for soil nutrients and light, it was most likely that they would produce more and bigger sized fruits (Sanchez et al., 1993). On other side, the overlapping of plants at the closest spacing might have resulted in competition for light and soil nutrients leading to low fruit performances when compared to the wider spaced plants. Similar findings were also reported by Nanthakumar and Veeraraghavathatham (2000) and Anburani et al. (2003) in eggplant.

The closer spacing (1 × 1 m) recorded the highest marketable yield in both main and ratoon crops. This could be attributed to the highest number of plants per hectare. Similarly, Reddy et al. (1990) observed in eggplant that the highest yield per hectare was obtained at the closest spacing. Mishriky and Alphonse (1994) reported in bell pepper cv. California wonder that the number of fruits and yield per plant were decreased; however, total yield per hectare was increased with closer spacing. In addition, Singh and Saimbhi (1998) opined that the magnitude of yield is influenced by plant population and its distribution pattern, which are important for getting maximum economic yield from a given field area. Comparable results were also obtained by Saglan and Yazgan (1995) in tomato.

The highest nutrition level (125% RDF) resulted in highest fruit weight; this might be due to the fact that nitrogen up to certain level increases shoot and leaf growth, which would have helped in the synthesis of greater amount of carbohydrates and more efficient protein synthesis to the developing fruits and that may have resulted in increased number of cells as well as elongation of individual cells. This in turn might have enhanced the size of fruits. Similar findings were also quoted by Reddy et al. (1990) in eggplant and Gare (2000) in chilli. Furthermore, phosphorus as an important constituent of nucleoproteins is involved in high energy transfer compounds such as adenosine diphosphate and adenosine triphosphate and plays a key role in energy transfer in the metabolic processes and thus, it would have contributed to the process. The potassium up to certain level would have also encouraged better utilization of assimilates through efficient transport to the developing fruits which acts as active sinks in eggplant (Clarkson and Hanson, 1980). In fact, the essential elements, particularly the primary nutrient elements N, P and K are supplied to plants to increase crop production (Nandekar and Sawarkar, 1990). Prabhu et al. (2006) also reported in eggplant that the fruit size and weight increased with increasing levels of N and P. The superiority of 100 over 125% RDF for fruit weight and number of marketable fruits per plant could be attributed to the fact that the excess nitrogen fertilizer application is associated with vigorous vegetative growth and extended duration for flower bud appearance, leading to the reduction in potential number of fruits per plant.

Batal et al. (1994) and Everaarts (1994) opined that excessive nitrogen fertilization may increase crop susceptibility to pests, diseases and physiological disorders, and will not always ensure that marketing yield is increased. Similar results were found by Birbal et al. (1995) in okra, He and Chen (1996) in tomato and Suthar et al. (2005) in eggplant.

Conclusion

In eggplant grafts, the 1 × 1 m spaced plants and applied with 100% RDF recorded lowest number of days to 50% flowering (31.50 and 16.50 days) and days to first harvest (45.50 and 33.25 days) as well as the highest marketable fruit yield (110.25 and 52.42 t/ha) for main and ratoon crops, respectively. Therefore, cultivation of eggplant grafts under 1 × 1 m spacing along with 100% RDF (200:150:100 kg NPK/ha) through drip fertigation is recommended, due to its superiority for earliness and high marketable yield over other treatment combinations.

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REFERENCES

Anburani A, Manivannan K, Shakila A (2003). Integrated nutrient and weed management on yield and yield parameters in brinjal (*Solanum melongena* L.) cv. Annamalai. Plant Archives 3(1):85-88.

Arao T, Takeda H, Nishihara E (2008). Reduction of cadmium translocation from roots to shoots in eggplant (Solanum melongena) by grafting onto Solanum torvum rootstock. Soil Sci. Plant Nutr. 54(4):555-559.

Batal K, Bondari K, Granberry D, Mullinix B (1994). Effects of source, rate, and frequency of N application on yield, marketable grades and rot incidence of sweet onion (Allium cepa L. cv. Granex-33). J. Hortic. Sci. p. 69.

Birbal K, Nehra BK , Malik YS (1995). Effect of spacing and nitrogen fertilizer on fruit yield of okra, cv. Varsh Upland. Haryana Agric. Univ. J. Res. pp. 2547-2551.

Clarkson DT, Hanson JB (1980). The mineral nutrition of higher plants. Annu. Rev. Plant Physiol. 31(1):239-298.

Colla G, Rouphael Y, Cardarelli M, Salerno A , Rea E (2010). The effectiveness of grafting to improve alkalinity tolerance in watermelon. Environ. Exp. Bot. 68(3):283-291.

Everaarts A (1994). Nitrogen fertilization and head rot in broccoli. NJAS wageningen J. life Sci. 42(3):195-201.

Gare B, More S, Jadhav M , Burli A (2000). Effect of spacing and fertilizer on yield of rainfed chilli in sub-montane zone of Maharashtra. J. Maharashtra Agric.Univ. 25(3):270-271.

Gisbert C, Prohens J, Raigón MD, Stommel JR , Nuez F (2011). Eggplant relatives as sources of variation for developing new rootstocks: Effects of grafting on eggplant yield and fruit apparent quality and composition. Sci. Hortic.128(1):14-22.

He W , Chen D (1996). Effect of different levels of fertilizer application on growth of tomato seedlings grown in seedling trays. Beijing Agric. Sci. 4(2):22-24.

Hebbar S, Ramachandrappa B, Nanjappa H , Prabhakar M (2004). Studies on NPK drip fertigation in field grown tomato (*Lycopersicon esculentum* Mill.). Euro. J. Agron. 21(1):117-127.

Ibeawuchi II, Njoku M, Edna MO, Anyanwu CP, Onyia VN (2008). Plant spacing, dry matter accumulation and yield of local and improved maize multivars. J. Am. Sci. 4(1):545-1003

King SR, Davis AR, Liu W , Levi A (2008). Grafting for disease resistance. Hortic. Sci. 43(6):1673-1676.

Kubota C (2006). Published. Use of grafted seedlings for vegetable production in North America. XXVII International Horticulture Congress-IHC2006: International Symposium on Cultivation and Utilization of Asian. 770:21-28.

Lee J-M (1994). Cultivation of grafted vegetables I. Current status, grafting methods, and benefits. Hortic. Sci. 29(4):235-239.

Mishriky JF, Alphonse M (1994). Effect of nitrogen and plant spacing on growth, yield and fruit mineral composition of pepper (*Capsicum annuun* L). J. Fac. Agri. Cairo. 45(2):413-433.

Nandekar D , Sawarkar S (1990). Effect of plant nutrients (NPK) on different varieties of brinjal (Solanum melongena L.). Orissa J. Hort. 18(1-2):1-5.

Nanthakumar S, Veeragavathatham D (2000). Effect of integrated nutrient management on growth parameters and yield of brinjal (Solanum melongena L.) cv. PLR-1. South Indian Hortic. 48(1/6):31-35.

Prabhu M, Veeraragavathatham D, Srinivasan K, Natarajan S (2006). Effect of nitrogen and phosphorus on earliness and yield of brinjal hybrid COBH-1. Agric. Sci. Digest. 26(3):218-220.

Rajangam J (1991). Studies on the influence of planting density and nitrogen levels on growth, yield and quality of chilli (*Capsicum annuum* L.) cv. CO 2. MSc, TNAU.

Reddy P, Madager B , Abbasshussan L (1990). Investigation on varietal performance, spacing and fertilization on bringal (*Solanum melongena* L). Mysore J. Agric. Sci. 22(4):490-492.

Saglan N, Yazgan A (1995). The effects of planting density and the number of trusses per plant on earliness, yield and quality of tomato grown under unheated high plastic tunnel. International Symposium on Solanacea for Fresh Market. 412:258-267

Sanchez VM, Sundstrom F , Lang NS (1993). Plant size influences bell pepper seed quality and yield. Hortic. Sci. 28(8):809-811.

Schwarz D, Rouphael Y, Colla G, Venema JH (2010). Grafting as a tool to improve tolerance of vegetables to abiotic stresses: Thermal stress, water stress and organic pollutants. Sci. Hortic. 127(2):162-171.

Sebahattin C, Coskun D, Berivan O, Sener K, Ozdemir B (2005). Comparison of grafted biennial and conventional production systems for eggplant (*Solanum melongena* L.) varieties in a mediterranean region of Turkey. Asian J. Plant Sci. 4(2): 117-122.

Singh H , Saimbhi (1998). Effect of plant spacing in brinjal (*Solanum melongena* L.). A review. Punjab veg. growers. pp.3311-3314.

Suthar MR, Singh GP, Rana MK , Makhan L (2005). Growth and fruit yield of brinjal (*Solanum melongena* L.) as influenced by planting dates and fertility levels. Crop Res. J. 30(1):77-79.