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Efficacy of Liquasorb on Morphological characters and yield components in tomato

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SUMMARY

A field experiment was conducted during *Rabi* 2008-09 at Main Research Station College of Agriculture, University of Agricultural Sciences, Dharwad to study the efficacy of liquasorb on morphological features and yield components in tomato. The treatments consisted of different concentrations of liquasorb (0.50 to 1.75 g/plant) and another was control. These treatments were imposed at the time of transplanting of seedlings. The results of the investigation revealed that among the treatments the application of liquasorb (1.75 g/plant) into the soil increased significantly the morphological such as plant height , number of branches per plant , canopy spread (top and middle) continuously during the peak growth period of crop, root length(47.6 cm/ plant), root fresh weight(30.7 g/plant), root dry weight (21.6 g/plant) , root volume(33.5 cc/plant)and yield component as number of fruits /plants(92.8), fruits volume /pants(6111.0 cc) and fruits yield(5.61 kg plant^{-1} and 36.6 tons ha^{-1}) as compared to all other treatment while lowest value to all morphological and yield component was recorded in control. The results of this study have shown morphology could be improved by adding liquasorb to the soil as the polymer in soil can store extra water and enable to the plants to utilize that water over an extended period of time, which maintained proper growth and development of crop plants.

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Key words : Canopy spread, Fruit and root volume, Liquasorb, Morphology, Root length

Tomato [*Lycopersicum esculentum* (L.) Mill.] is one of the most important vegetable crops grown widely all over the world. It is a self-pollinated crop and is a member of Solanaceous family with 2n = 24 chromosomes. Peru Equador region is considered to be the center of origin (Rick, 1969). English traders of East India Company introduced tomato into India in eighteenth century. Tomato is one of the most popular and widely growing vegetables around the world either outdoors or indoors. Water is the most abundant constituent of all organisms including plants. Among the main fruits and vegetables, tomato ranks 16th as source of vitamins. Tomatoes are important source of lycopene, minerals, vitamin-A, B and also excellent source of vitamin-C. Ripe tomato fruit is consumed fresh as salad and utilized in the preparation of range of processed products such as powder, ketchup, soup, canned fruit. Tomato is very good appetizer and its soup is said to be good remedy for patient suffering from constipation. Raw or unripe green fruit are used for preparation of pickles and chutney Tomato is also rich in medicinal value. The pulp and juice are digestible and blood purifier. It is reported to have antiseptic properties against intestinal infections. The epidemiological studies revealed that, vegetables containing high levels of photochemical to lower the risk of several chronical diseases. Frasher *et al.* (1991) reported decreased cancer risk with the intake of tomatoes. This neutraceutical effect of tomato is attributed to 'lycopene' a major carotenoids present in tomatoes. Lycopene has a straight chain of hydrocarbons containing 12 conjugated and 2 non-conjugated double bonds. The use of hydrophilic polymers, particular under green house condition has shown that they have great potential to hold water and release slowly for crop growth and development. Polymeric soil conditioners were known since the 1950s (Hedrick and Mowry 1952). The present study is aimed at arriving appropriate concentration of and liquasorb to see efficacy on morphological features

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and yield components in tomato.

MATERIALS AND METHODS

The experiment was carried out in plot No.125 belonging to Department of Crop Physiology, University of Agricultural Sciences, Dharwad. Tomato seedlings of variety Shakatiman were obtained from KLE nursery Pvt. Ltd., Belgaum and transplanted in October, 2008. The experiment was laid out in randomized block design with three replications. The treatments involving different concentrations of liquasorb were imposed in soil at the time of transplanting of tomato. For the investigation of morphological feature, three plants were select randomly and measured the all parameters at different growth stage up to harvesting of crop plant. The plant height was measured from the base of the plant to the terminal growing point of the main stem and the average plant height was expressed in centimeters. The maximum growth of the plant in either directions (North-south or East-West) was measured in centimeter and average of growth is considered as the canopy development of crop. While the yield components such as number of fruits / plant, fruits yield kg /plant work out at time of harvesting and root volume as well as fruits volume were determined by water displacement method. Randomly selected plants roots as well as fruits were immersed individually in a container containing water and the amount of water expelled out by each fruits and roots were measured using measuring cylinder and then the average volume of roots and fruits were expressed in cubic centimeter (cc/plants).

RESULTS AND DISCUSSION

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

The results on morphological features *viz*., plant height (cm/plant), plant canopy (top and middle, cm / plant)and number of branches per plant, were obtained at different stages of crop growth as influenced by the liquasorb treatments and discussed below.

Morphological characters:

Plant height (cm/plant):

The data on plant height presented in Table 1 indicated significant differences between the treatments at all the stages except at 20 and 40 DAT. At 60 DAT, treatments differed significantly in plant height and T_6 recorded significantly higher plant height (95.2 cm) as compared to all other treatments. While significantly lower plant height was recorded in control (83.9 cm).Similarly Sivalapan (2001) also showed that the application of polymer (ALCOSORB®400) at 0.05, 0.1, 0.2, and 0.3% by weight into the soil increased the plant height with increasing concentration in soybean cv. Stephens.

Top and middle canopy spread (cm):

Top canopy spread differed significantly between the treatments at all the stages and was found to be progressively increasing with advancement in crop growth (Table 2 and 3).At 60 DAT, T_6 recorded significantly higher top and middle canopy spread (43.4 cm and 56.2cm) followed by T_5 (42.2 cm and 54.7 cm), respectively similar trend was obtained at 80 DAT and at harvest. Same as Anupama *et al.* (2005) reported that the performance of hydrogel (0.5% wt/wt) in the soil less media in chrysanthemum cv. Yellow bouque grown under controlled environment exhibited most prominent growth with plant height (84.0 cm), stem diameter (1.1 cm), number of leaves per plant (103), number of flowers per plant (14) and flower size (21cm^2) as compared to control.

Table 1 : Influence of hydrophilic polymer (Luquasorb) on plant height (cm) at different stages in tomato

Treatments	Days after transplanting				
	20	40	60	80	At harvest
T_1(HP@0.50 g/plant)	29.2	68.8	84.7	86.4	88.5
T_2 (HP@ 0.75 g/plant)	29.7	69.6	57.1	89.9	90.6
T_3 (HP@ 1.00 g/plant)	32.0	70.1	89.2	91.3	92.4
T_4 (HP@ 1.25 g/plant)	33.7	72.3	91.0	93.4	94.2
T_5 (HP@ 1.50 g/plant)	34.4	73.0	93.1	95.3	96.8
T_6 (HP@ 1.75 g/plant)	35.5	73.5	95.2	96.7	98.4
T_7 (Control)	28.9	67.7	83.9	85.6	87.9
Mean	31.9	70.7	89.2	91.2	92.7
S.E. (±)	2.60	2.58	0.51	0.35	0.46
C.D. (P=0.05)	NS	NS	1.53	1.06	1.40

NS =Non-significant

Table 2 : Influence of hydrophilic polymer (Liquasorb) on top canopy development (cm) at different stages in tomato

Treatments	Days after transplanting				
	20	40	60	80	At harvest
T_1(HP@0.50 g/plant)	17.8	32.5	34.8	38.7	43.3
T_2 (HP@ 0.75 g/plant)	18.3	33.5	36.7	39.2	45.7
T_3 (HP@ 1.00 g/plant)	19.1	33.9	37.5	40.7	46.8
T_4 (HP@ 1.25 g/plant)	19.4	35.3	38.8	42.1	48.5
T_5 (HP@ 1.50 g/plant)	20.1	37.2	42.2	44.5	49.1
T_6 (HP@ 1.75 g/plant)	20.4	37.9	43.4	46.0	50.1
T_7 (Control)	17.1	31.6	32.1	36.9	41.3
Mean	18.9	34.55	37.9	41.1	46.4
S.E. (±)	1.16	2.29	0.85	0.34	0.40
C.D. (P=0.05)	NS	NS	2.56	1.06	1.24

NS =Non Significant

Table 3 : Influence of hydrophilic polymer (Liquasorb) on middle canopy development (cm) at different stages in tomato

Treatments	Days after transplanting				
	20	40	60	80	At harvest
T_1(HP@0.50 g/plant)	24.1	37.3	46.5	50.93	51.8
T_2 (HP@ 0.75 g/plant)	24.4	38.0	48.3	52.8	54.7
T_3 (HP@ 1.00 g/plant)	26.5	38.7	49.7	55.7	57.3
T_4 (HP@ 1.25 g/plant)	27.2	40.4	50.1	58.8	59.5
T_5 (HP@ 1.50 g/plant)	27.7	41.2	54.7	60.4	62.4
T_6 (HP@ 1.75 g/plant)	28.5	41.8	56.2	62.7	65.1
T_7 (Control)	23.1	36.7	42.7	47.1	48.9
Mean	25.9	39.2	49.7	55.5	57.1
S.E.(±)	2.28	2.23	0.67	0.89	0.79
C.D. (P=0.05)	NS	NS	2.01	2.67	2.37

NS =Non Significant

Table 4 : Influence of hydrophilic polymer (Luquasorb) on number of branches per plant at different stages in tomato

Treatments	Days after transplanting				
	20	40	60	80	At harvest
T_1 (HP@ 0.50 g/plant)	7.1	11.0	13.6	18.8	21.1
T_2 (HP@ 0.75 g/plant)	7.4	11.8	15.9	20.8	22.6
T_3 (HP@ 1.00 g/plant)	7.6	11.9	17.3	22.0	24.2
T_4 (HP@ 1.25 g/plant)	8.1	12.6	18.6	23.3	25.6
T_5 (HP@ 1.50 g/plant)	8.9	13.9	20.4	24.1	26.3
T_6 (HP@ 1.75 g/plant)	9.2	14.5	22.6	25.1	27.0
T_7 (Control)	6.9	10.9	12.7	17.7	20.4
Mean	7.8	12.4	17.3	21.7	23.9
S.E. (±)	0.96	1.36	0.46	0.34	0.35
C.D. (P=0.05)	NS	NS	1.40	1.05	1.07

NS=Non-significant

Number of branches per plant:

The data on number of branches per plan presented in Table 4 indicated significant differences between the treatments at all the stages except at 20 and 40 DAT. At 60 DAT, significantly less number of branches per plant was recorded in control (12.7) as compared to all other treatments. However, significantly higher number of branches per plant was recorded in T_6 (22.6), which were significantly superior over rest of the treatments including control.. A similar trend was continued at 80 DAT and at harvest with T_6 recorded significantly higher number of branches per plant over other treatments. These results are similar to Zhang *et al.* (2005) who studied the response of hydrophilic polymer which under different water gradients on growth characteristics of an ornamental plant *Parthenocissus quinquefolis* and concluded that polymer significantly increased number of leaves, number of branches and leaf and root biomass over control.

Root parameters:

Root length (cm):

The data on root length (Table 5) indicated significant differences between the treatments. Among the treatments, T_6 recorded significantly higher root length (47.6 cm) followed by T_5 (46.1 cm). While T_1 and T_2; T_2 and T_3 were at par with each other. Significantly lower root length (39.4 cm) was recorded in control (Fig. 2).

Root volume (cc):

Table 5 indicated that the root volume significantly differed among all treatments and T_6 recorded the maximum root volume (33.5 cc) followed by T_5 (33.0 cc) as compared to all other treatments. Significantly lower root volume was recorded in control (24.1 cc)

Root fresh and dry weight (g):

The data on root fresh and dry weight indicated significant differences between the treatments and it was maximum in T_6 (30.7 g and 21.6 g, respectively) followed by T_5 (29.6 g and 19.2 g, respectively) which differed significantly with rest of the treatments (Table5). Significantly lower fresh and dry weight was recorded in control (22.8 g and 14.7 g, respectively). Same as the study conducted by Volkamar and Chang (1995) on the influence of hydrophilic polymer on barley var. letuc reported that the polymer (Grogel @1.87 g/plant) increased root biomass (4.5 g/plot) as compared to control (2.5 g/plot).

Yield and yield component:

Fruit parameters:

The data on fruit parameters (number of fruits, fruit volume per plant and fruit yield) as influenced by hydrophilic polymer (HP) presented in Table 6 indicated significant differences between the treatments. The treatment T_6 recorded significantly higher number of fruits per plant (92.8) and fruit volume (6111.0 cc) followed by T_5. Significantly less number of fruits (78.5) and fruit volume (4270.3 cc) was observed in control (Fig. 1 and 3).

Fruits yield (kg plant^{-1} and tons ha^{-1}):

The data presented in Table 6 indicated significant differences between the treatments with respect to fruit

Table 5 : Effect of hydrophilic polymer on root characteristics at harvest in tomato

Treatments	Root length (cm)	Root volume(cc)	Root fresh weight(g)	Root dry weight (g)
T_1(HP@0.50 g/plant)	40.2	25.9	24.6	15.4
T_2(HP@0.75 g/plant)	41.7	28.7	26.7	16.5
T_3(HP@1.00 g/plant)	42.9	30.4	27.8	16.8
T_4(HP@1.25 g/plant)	45	31.1	28.8	17.5
T_5(HP@1.50 g/plant)	46.1	33.0	29.6	19.2
T_6(HP@1.75 g/plant)	47.6	33.5	30.7	21.6
T_7 (Control)	39.4	24.1	22.8	14.7
Mean	43.3	29.6	27.3	17.4
S.E. (±)	0.45	0.32	0.51	0.49
C.D. (P=0.05)	1.39	0.98	1.53	1.47

Table 6 : Influence of hydrophilic polymer (Luquasorb) on yield and yield parameters

Treatments	No. of fruits/plant	Fruit yield (kg/plant)	Fruit yield (t/ ha)	Fruit volume(cc/plant)
T_1(HP@0.50 g/plant)	80.2	4.65	28.5	4772.0
T_2(HP@0.75 g/plant)	84.3	4.77	31.3	4934.7
T_3(HP@1.00 g/plant)	85.3	4.94	32.7	5130.3
T_4(HP@1.25 g/plant)	88.7	4.96	34.2	5231.0
T_5(HP@1.50 g/plant)	91.5	5.19	35.9	5836.3
T_6(HP@1.75 g/plant)	92.8	5.61	36.6	6111.0
T_7 (Control)	78.5	4.45	26.9	4270.3
Mean	85.9	4.94	32.3	5183.67
S.E.(±)	2.40	0.07	0.67	137.53
C.D. (P=0.05)	7.30	0.20	2.03	411.46

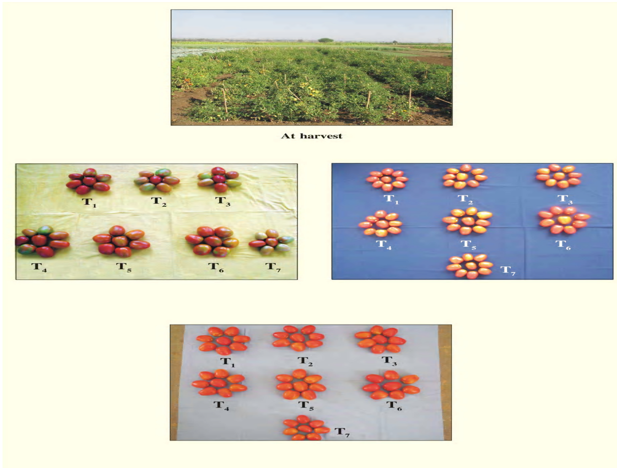

Fig. 1 : Influence of hydrophilic polymer (Luquasorb) on fruits at harvest in tomato

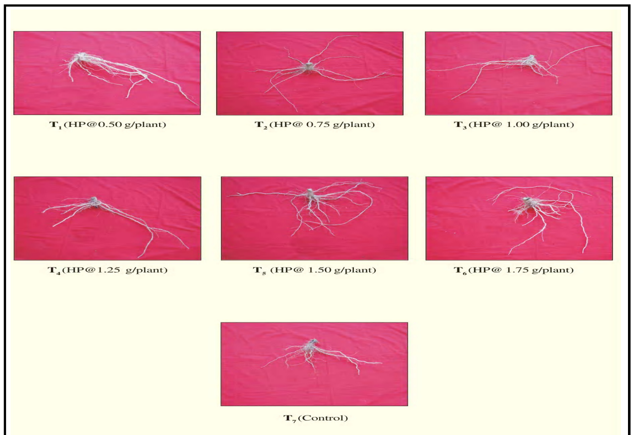

Fig. 2 : Influence of hydrophilic polymer (Luquasorb) on root at harvest in tomato

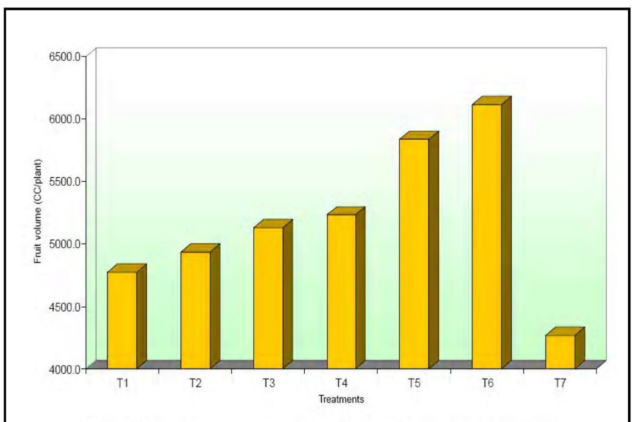

Fig. 3 : Influence of hydrophilic polymer (Luquasorb) on fruits volume at different stages in tomato

yield. The treatment T_6 recorded significantly higher fruit yield (5.61 kg plant^{-1} and 36.6 tons ha^{-1}) followed by T_5 (5.19 kg plant^{-1}, 35.9 tons ha^{-1}, respectively) as compared to other treatments. While, lowest was recorded in control (4.45 kg plant^{-1} and 26.9 tons ha^{-1}, respectively). The effects of hydrophilic gel polymer on the yield of barley studied by Volkamar and Chang (1995) showed that grain yield of barley increased by 15 per cent and biomass by 23 per cent by a polymer @ 1.87 g/kg soil, which was due to either more grains per spike or larger grains. Similarly Sivalapan (2001) found that soybean cv. Stephens grown in soil treated with 0.05, 0.1and 0.2% polyacrylamide (PAM) achieved grain production which was about 6, 9 and 14 times greater, respectively than in control soil under three days of irrigation interval.

The significant increase in plant height and number of branches per plant were noticed due to soil application of hydrophilic polymer. With an increase in concentration of hydrophilic polymer, there was increase in plant height and number of branches per plant at all stages. This increase in plant height and number of branches per plant was due to more retention of moisture and indirectly the availability of nutrients provided by hydrophilic polymer, where it might have helped to increase the activity of cell division, expansion and elongation, ultimately leading to increased plant height and number of branches. Similar results have been reported by Al-Harbi *et al*. (1996) in cucumber, Sivalapan (2001) in soybean and Sendur Kumaran *et al*. (2001) in tomato.

With an increase in concentration of hydrophilic polymer (HP), significantly increased the root parameters like root length, root volume, root fresh and dry weight at harvest in tomato due to proper maintenance of water by hydrophilic polymer (HP) for longer duration. Similarly, Sendur Kumaran *et al*. (2001) reported the influence of hydrophilic polymer (HP) on root characteristics in tomato.

Hydrophilic polymer significantly reduced the number of irrigation frequency in tomato by increasing water holding capacity of soil which is in accordance with the results observed by Sivalapan (2001) in soybean, Cookson *et al*. (2001) in okra and Abedi-Koupai and Asad Kameni (2004) in *Cupressus*. The present study indicated that the yield determining components such as number of fruits, fruits weight and fruit volume were found to be significantly higher with an increase in the concentration of hydrophilic polymer. An improvement in yield contributing characters may be due to increase in plant height, plant canopy spread (top and middle), growth parameters, chlorophyll content and nitrate reductase activity which are influenced by the application hydrophilic polymer (HP). An increase in growth and yield related attributes in the present investigation could be because of sufficient availability of water and indirectly nutrients supplied by the hydrophilic polymer (HP) to the plants in water stress condition, which in turn led to better translocation of water, nutrients and photoassimilates and finally better plant development. Similar results have been reported by Sivalapan (2001) with the soil incorporation hydrophilic polymer in soybean, Sendur Kumaran *et al*. (2001) in tomato (Fig. 1).

Conclusion:

Since irrigation water is a limiting factor in the country; it is important to improve the water use efficiency of the plants. The use of water retaing polymers has potential for horticultural and other crops. The results of this study have shown that the crop growth parameters were increasing due to use of hydrophilic polymer and yield is positively related to all growth parameters that's why yield could be improved by adding hydrophilic polymer to the soil as the polymer in soil can store extra water and enable to the plants to utilize that water over an extended period of time.

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