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Effect of foliar application of resorcinol on certain biochemical parameters and yield of soybean

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The effect of various concentrations of foliar application of resorcinol on chlorophyll contents, shoot root dry matter production and yield (pod size and weight per 100 seed) were studied in soybean. Chlorophyll contents and shoot root dry matter production were found to decreased at all the growth stages whereas, pod size and weight per 100 seed and pod size found to increased maximum at R_2 stage with 1000 ppm resorcinol application. Higher concentrations of resorcinol at R_2 stage were also detrimental. At R_2 stage leaves have maximum assimilates and foliar application of lower concentration of resorcinol helps in remobilization of assimilates from vegetative part to reproductive part, which result in improved yield. It can be concluded that resorcinol can be used as partitioning agent to improve the productivity when it is used at appropriate growth stage with its optimum concentration.

Key words: Chlorophyll contents, Dry matter production, Pod size, Weight per 100 seeds, *Glycine max* L., Resorcinol.

INTRODUCTION

SENESCENCE is a programmed, active process that enables the plant to use the nutrients from photosynthetic tissues for the development of seeds. From a practical point of view expanding our knowledge about the process of plant senescence it is found that senescence has an important role in determining the yield and pre-harvest quality of many crops (Wollaston and Greenberg, 2004). Soybean (*Glycine max* L.) is a miracle crop. The demand of soybean may also be increased due to new awareness of health benefits of consuming soy products such as tofu, soy milk, soy flour and soy sauce. Senescence is an active process that involves remobilization of stored food from stems and sheath to the grains (Gan and Amasino, 1997; Noodén *et al*., 1997; Ori *et al*., 1999). Therefore increased knowledge of the regulation and processes of senescence will provide information to generate crop with improved yield. It is reported that foliar application of some chemicals helps in transportation of assimilates. Kaur and Jagetiya (2004) observed that use of resorcinol at 10 days just after seed set improved yield in sarson by shifting assimilated partitioning from leaf to pod. Present paper deals how the foliar application of different concentrations of phenolic compound (resorcinol) on various stages of soybean can accelerate remobilization of assimilate from vegetative to reproductive part with improved yield.

MATERIALS AND METHODS

The experiment was conducted to find out the effect of foliar spray of different concentration of resorcinol on chlorophyll contents, shoot root dry matter production and yield of soybean. Certified seeds of soybean were surface sterilized with 0.1% (W/V) $HgCl_2$ for one minute and washed well in running water. Water soaked seeds were then sown in the first week of August in earthen pots (30cm height and 18cm diameter) containing 5 kilograms mixture of garden soil. The pots were placed in such a manner that all the plant parts could intercept light. Watering was done at regular intervals. Different concentrations of Resorcinol (1000, 1500 and 2000 ppm) were sprayed at V_2, V_6, R_2 and R_8 stage. Three replicates were set for each treatment in completely randomized block design. Leaf samples were collected after 4 days of foliar treatment for biochemical analysis. Yield (pod size and weight per 100 seeds) was estimated after pod maturation.

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RESULTS AND DISCUSSION

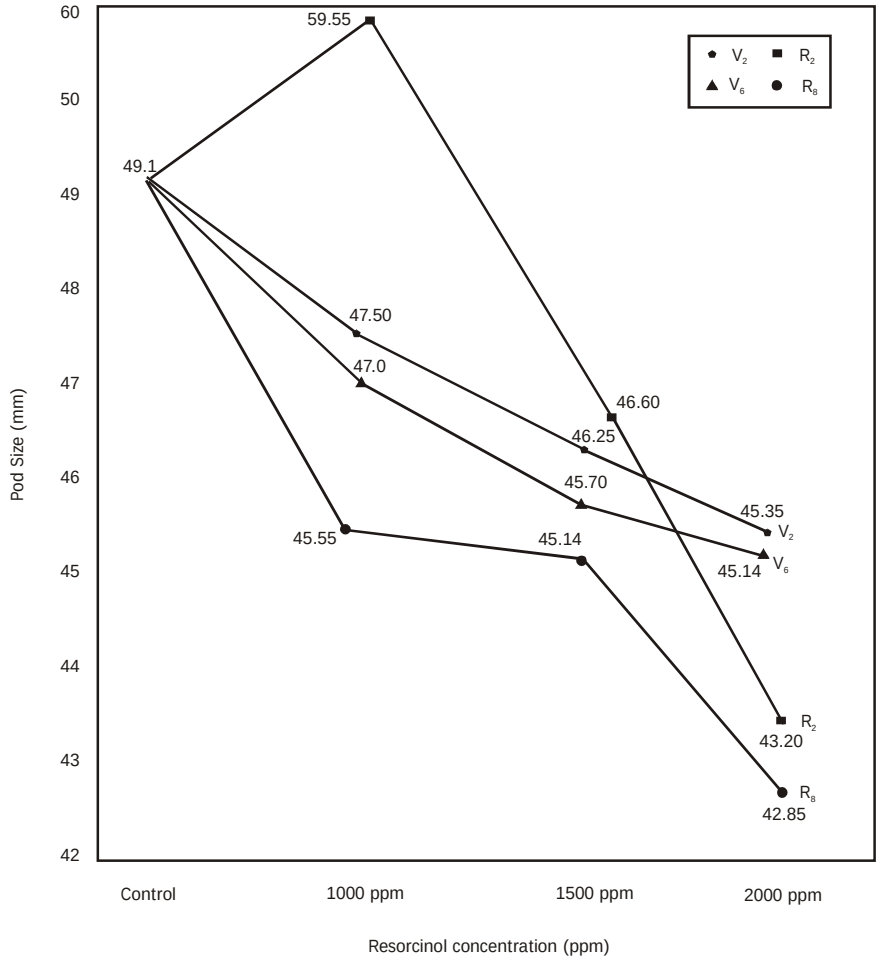
The plants, which have only one reproductive phase followed by death are called monocarpic and those have more than one reproductive phase before death are known as polycarpic. Monocarpic senescence is usually induced by reproductive structure that is so evident in soybean and many other monocarpic species (Hensel *et al*., 1993). Mechanism by which plant senescence promotes remobilization of assimilate are rather obscure. Many factor contributes to plant senescence and remobilization. Plant growth regulators (PGRs) are certain chemical compounds, when applied in minute amounts, alter the growth of plants in many ways (Weinhong, 1996). Chemicals (PGRs), which can improve partitioning at reproductive stage and remobilizes the nutrients from vegetative structures into the fruits and seeds are highly demanding. Resorcinol is a phenolic compound and it is also known as 3-hydroxy phenol, 1,3 benzene diol. Some phenolic compounds and growth hormones such as ABA are reported to be important in regulating the transporting assimilates to developing seeds and fruits (Brenner and Cheikh, 1995; Yang *et al*., 1999; Tadas *et al*., 1999). Different phenol had marked effect on hastening of emergence of ears, increase in number of branches, seed/ear and seed weight in Italian millet (Nanda *et al*., 1977). Datta and Nanda (1978) also reported that application of different phenols increased the yield in many plants. Parmer *et al*., (1985) concluded that phenols increased number of tillers in rice. Singh and Kaur (1981) observed that growth was increased in mungbean with the application of phenols. Chandar (1982) tried different phenols in *Vigna radiata* as foliar spray and observed promotory effects. Malik *et al*., (1986) found that foliar spray of phenolic compounds (H-acid, resorcinol, RD Brown) increased yield and number of pods per plant in peanut. Kaur and Jagetiya, 2004 observed that foliar treatment of resorcinol increases number of seed per pod and weight per 100 seeds in sarson (*Brassica compestris* L.).

In present investigations decrease in chlorophyll contents and shoot root dry matter production were observed at all concentrations of resorcinol. The decrease in chl 'a', chl'b' and total chlorophyll at 2000 ppm resorcinol treatment for V_2, V_6, R_2 and R_8 stages were 65.05%, 41.81%, 63.07%; 41.98%, 49.36%; 41.52%; 42.79%, 28.92%, 39.09% and 44.68%, 68.33%, 45.65%, respectively over the control (Table-1). All the resorcinol application rates decreased the dry matter production over the control at V_2, V_6, R_2 and R_8 stages. Maximum decrease in dry matter was observed at 2000 ppm foliar treatment of resorcinol at each growth stage. The percentage decrease in shoot and

Table 1: Showing chlorophyll contents (mg g^{-1} fresh weight) and % increase/decrease over the control in *Glycine max* L. during different growth stages under different treatments of resorcinol

Resorcinol Concentration (ppm)	V_2			V_6			R_2			R_8		
	Chl'a'	Chl'b'	Total Ch1	Chl'a'	Chl'b'	Total Chl	Chl'a'	Chl'b'	Total Chl	Chl'a'	Chl'b'	Total Chl
Control	0.887 ±	0.275 ±	1.30 ±	1.81 ±	0.395±	2.29 ±	1.93 ±	0.605 ±	2.66 ±	0.235 ±	0.03 ±	0.276 ±
	0.123	0.078	0.140	0.091	0.007	0.087	0.084	0.021	0.084	0.007	0.002	0.005
1000	0.710±	0.255 ±	0.975	1.59 ±	0.355±	2.04±	1.77 ±	0.585 ±	2.48 ±	0.215 ±	0.026 ±	0.265 ±
	0.014	0.077	±0.007	0.035	0.021	0.07	0.007	0.021	0.05	0.007	2.82	0.007
	(-19.95%)	(-7.27%)	(-25.00%)	(-12.15%)	(-10.12%)	(-10.91%)	(-8.2%)	(-3.30%)	(-6.76%)	(-8.5%)	(-13.33%)	(-3.98%)
1500	0.595±	0.205±	0.795±	1.495±	0.330±	1.885±	1.61 ±	0.525±	2.265 ±	0.195 ±	0.019 ±	0.226 ±
	0.007	0.021	0.134	0.007	0.014	0.02	0.014	0.007	0.063	0.007	2.12	0.006
	(-32.91%)	(-28.00%)	(-38.84%)	(-17.40%)	(-16.45%)	(-17.68%)	(-16.58%)	(-13.22%)	(-14.84%)	(-17.02%)	(-36.66%)	(-18.11%)
2000	0.310±	0.160 ±	0.480±	1.05 ±	0.200±	1.33±	1.104±	0.430 ±	1.62 ±	0.130 ±	0.009 ±	0.150 ±
	0.014	0.014	0.028	0.084	0.014	0.042	0.149	0.056	0.042	0.014	0.0007	0.014
	(-65.05%)	(-41.81%)	(-63.07%)	(-41.98%)	(-49.36%)	(-41.92%)	(-42.79%)	(-28.92%)	(-39.09%)	(-44.68%)	(-68.33%)	(-45.65%)

Fig. 1 : Effect of Resorcinol concentration on pod size (mm) in *Glycine max* L. during different growth stages.



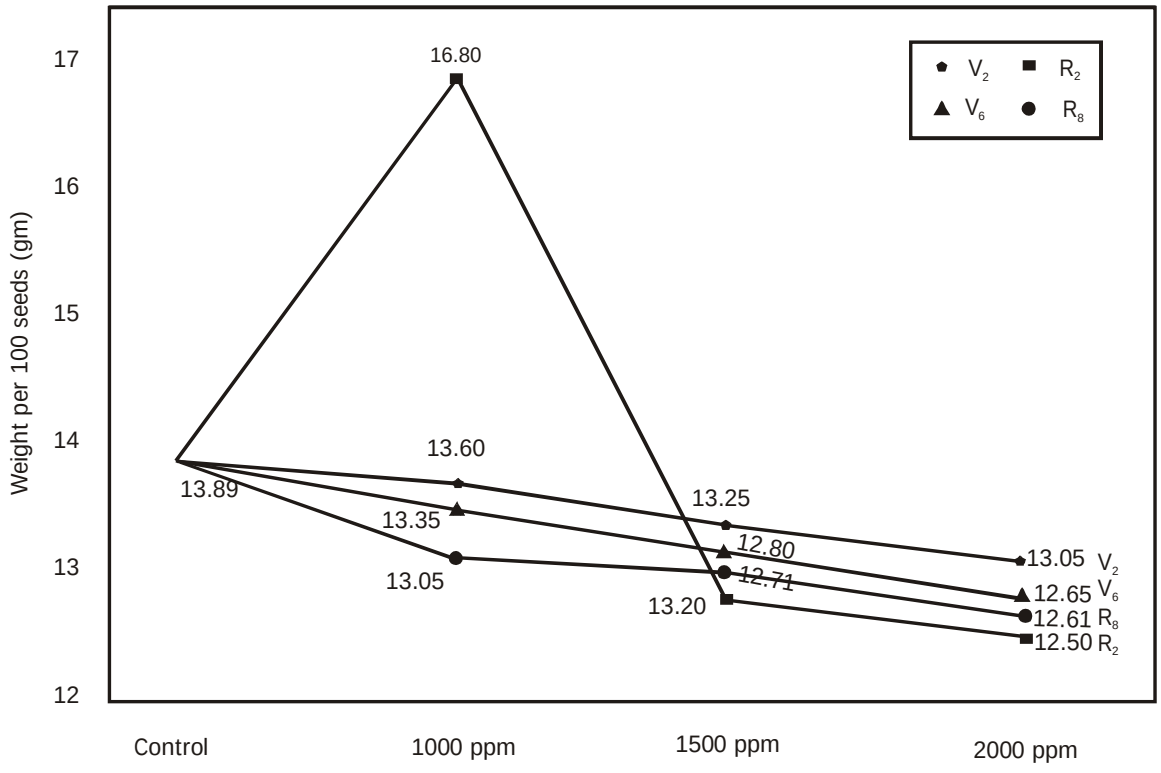
root dry matter for V_2, V_6, R_2 and R_8 stages were 25.80%, 33.25%; 22.61% 28.41%; 19.48% 29.62% and 37.23%, 49.20% respectively at above concentration of resorcinol (Table-2). The reduction in chlorophyll contents in present investigation may be attributed with the fact that phenolic compounds cause peroxidase mediated chlorophyll degradation. In this process peroxidase (Homoprotein) oxidizes the phenolic compounds with H_2O_2 and form phenoxy radicals, which oxidizes the chlorophyll (Dunford, 1986; Yamauchi *et al*., 2004). Decrease in the vegetative plant parts is observed at all the applied concentrations of resorcinol. Sabater (1984) concluded that protein degradation is parallel with the dimunution of the photosynthetic capacity of the leaf.

It is clear from the results that foliar treatment of resorcinol increased pod size and weight per 100 seeds with lower concentration of resorcinol (1000 ppm) at R_2 stage which was 21.28% and 20.95%, respectively over the control (Fig 1-2) whereas, decrease in pod size and weight per 100 seeds were observed at V_2, V_6, R_2 and R_8 stages when plants were treated with lower and higher concentrations of resorcinol. Foliar

Table 2 : owing root- shoot dry matter production (mg plant^{-1}) and % increase/decrease over the control in *Glycine max* L. uring different growth stages under different treatments of resorcinol

Resorcinol Concentration (ppm)	V_2		V_6		R_2		R_8	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Control	159.05±1.343	45.10 ±1.55	226.40± 8.20	69.15±1.484	269.50±7.77	81.0 ±1.41	67.0 ±4.24	15.95±1.060
1000	154.50 ±0.707	42.80 ±0.282	215.0 ±7.07	65.50±0.707	257.0 ±4.24	75.50±0.707	61.0 ±1.41	13.95±0.07
	(-2.86%)	(-5.09%)	(-5.03%)	(-5.27%)	(-4.63%)	(-6.79%)	(-8.95%)	(-12.53%)
1500	135.0 ±7.07	37.10 ±1.27	197.0 ±4.24	59.00 ±4.24	239.50±3.53	69.0 ±1.41	49.15± 1.48	9.50±0.707
	(-15.12%)	(-17.73%)	(-12.98%)	(-1.46%)	(-11.13%)	(-14.81%)	(-26.64%)	(-40.43%)
2000	118.0±2.82	30.10 ±2.68	175.30±2.30	49.50±3.53	217.0±4.24	57.0±4.24	42.05±2.89	8.10±0.424
	(-25.80%)	(-33.25%)	(-22.61%)	(-28.41%)	(-19.48%)	(-29.62%)	(-37.23%)	(-49.2%)

Fig. 2 : Effect of Resorcinol concentration on weight per 100 seeds (gm) in *Glycine max* L. during different growth stages.



treatments of resorcinol on *Glycine max* L. were detrimental at R_2 stage when its higher concentration was applied in contrary to its lower concentrations. It can be explained by the fact that at R_2 stage leaves have maximum assimilates and foliar application of lower concentration of resorcinol helps tranportation/ partitioning of nutrients/assimilates from vegetative parts to the developing fruits and seeds with improved yield.

our studies reveals that although resorcinol (phenolic compound) causes substantial decrease in chlorophyll and dry matter production and yield but the use of appropriate concentration of resorcinol (1000 ppm) at proper growth stage (R_2) can be useful for improving the yield in soybean. From our findings it is also concluded that resorcinol can be used as partitioning agent to improve the productivity in soybean and in other monocarpic crops.

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