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Salicylic acid induced responses on growth and biochemical constituents in *Vigna mungo* (L.) hepper

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ABSTRACT

Salicylic acid is an important secondary plant product performs important role in the growth and development processes of plant. It is a potent signaling molecule in plants and is involved in eliciting responses to biotic and a biotic stress. Salicylic acid has been studied as the phytohormone, mediating several responses in plants. The effect of foliar application of SA at 50, 100 and 150 ppm on Vigna mung. SA was applied as foliar spray at 3 days after sowing. Application of SA enhanced plant growth as indicated by plant height, fresh and dry weights. The plant height, fresh and dry weights was significantly maximum at 150 ppm concentration and control. These positive effects of SA were correlated with significant increase in total chlorophyll in leaves, total soluble protein total soluble sugar and NRA. Hence it is concluded that practice of application of SA to Vigna mungo can be recommended for attaining better production.

Key words: *Vigna mungo*, plant height, Chlorophyll, Carotenoid, total soluble protein total soluble suga, NRA, Salicylic acid

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INTRODUCTION

Salicylic acid or ortho – hydroxyl benzoic acid and other salicylates are known to affect various physiological and biochemical activities of plants and may play a key role in regulating their growth and productivity (Hayat et al., 2010). Salicylic acid is considered to be an endogenous growth regulator of phenolic nature that enhanced the leaf area and dry mass production in corn and soybean (Khan et al., 2003). Enhanced germination and seedling growth were recorded in wheat, when the grains were subjected to pre – sowing treatment in salicylic acid (Shakirova, 2007). Fariduddin et al., reported that the dry matter accumulation was significantly increased in Brassica juncea, when lower concentration of salicylic acid were sprayed. However, higher concentration of salicylic acid had an inhibitory effect.

The objective of this work is to investigate whether salicylic acid could be growth hormone to promote biochemical and physiological activities in intact vigna seedlings. *Vigna mingo* was selected as the model system due to its fast growing and responsive nature to SA.

MATERIALS AND METHODS

Cultivation of Plants

Healthy and uniform seeds were sown pots containing mixture of red soil, black soil, and sand mixed in the ratio of 2:2:1. The percentage of seed germination was 85%. The pots were kept in dark for overnight. Soon after seedling emergence, the pots were shifted to daylight conditions.

SA Foliar spray treatment

Salicyclic acid (SA- 2 hydroxybenzoic acid) obtained from Sigma Chemical Co.(St. Louis, U.S.A.) was initially dissolved in 100 ml of dimethyl sulfoxide and a stock solution of 5 mM was made up with distilled water containing 0.02% Tween-20 (Polyoxyethylene sorbitan). Only there concentrations viz., 50, 100 and 150 ppm were selected as they were found to induce significant responses in detached leaf system. The seedlings were sprayed with 50 ppm, 100 ppm and 150 ppm SA concentrations until dropping, with an atomic sprayer. Each plant required about 10 ml of SA solution. Those plants sprayed with 0.02% Tween-20 served as the control. The plants were arranged in a completely randomized design with three replicates (Khan et al., 2003).

After three days of the treatment the seedlings of *Vigna mungo* were used for measuring the growth parameters such as such as root length, shoot length, leaf area, fresh weight and dry weight were measured. The biochemical and enzymatic characters were analyzed by the following methods: chlorophyll and carotenoids (Wellburn and Lichtenthalar, 1984), anthocyanin (Swain and Hills, 1959), Total soluble sugar (Jayaraman, 1981), Protein content (Lowry *et al*., 1951), and *in vivo* nitrate reductase activity (Jaworski, 1971).

RESULTS AND DISCUSSION

Vegetative Growth Parameter

Effects of three different concentrations (50 ppm, 100 ppm and 150 ppm) of SA on the growth, and biochemical activities are represented in table 1. The result shows that the growth parameters such as root length, shoot length, leaf area, fresh weight and dry weight are increased with increase in the concentration of SA. Similarly chlorophylls, carotenoid, total soluble sugar, protein and NR activity also increased. In contrary the pigment anthocyanin and total free amino acid increased with increase in the SA concentration. EI Tayeb, 2005 reported that the Exogenous application of SA enhanced the photosynthetic rate and also maintained the stability of membranes, thereby improving the growth of SA stressed barley plants. Then SA was observed to reduce leaf area (secondary leaf), root growth, as much as protein and chlorophyll (*a* + *b*) amount parallel to an increase in its concentration in barley plants which were developed from barley seeds germinated in SA solutions (Pancheva *et al*., 1996). Khan *et al*. (2003) found that spraying ASA (10^{-5} M) on the leaves led to an increase in the overall photosynthetic yield of soybean and corn.

Table: 1 Effect of SA on growth analysis

Growth Characters	Control	Exogenous application of SA		
		50 ppm	100 ppm	150 ppm
Shoot length (cm)	30.19±0.4 (100%)	21.07±0.5 (63.4%)	27.85±0.66 (83.9%)	30.28±0.1 (91%)
Root length (cm)	7.2±0.316 (100%)	5.2±0.418 (56.5%)	6.58±0.303 (71.5%)	7.78±0.27 (84.5%)
Total Fresh Weight (g/seedling)	560±0.51 (100%)	321.3±0.4 (64.2%)	433.66±0.6 (86.7%)	454.6±0.4 (90.9%)
Total Dry weight (g/seedling)	106±0.49 (100%)	61.6±0.47 (57.9%)	82.3±0.668 (77.3%)	92.66±0.4 (87.4%)

The values in the parenthesis indicates percent activity
The values represents mean of 3 sample with their standard error (+/-)
Control- water
50 ppm, 100ppm and 150 ppm of SA

Effect of SA on Chlorophyll and Carotenoid content

SA significantly affected photosynthetic pigments (Chlorophyll a, b, and a+b). chlorophyll concentrations significantly increased when SA concentration was increased from 50 ppm to 150 ppm. High concentratins of chlorophyll a, b and a+b were obtained in vigna sprayed with 150 ppm of SA. With increase in SA concentration the

level of carotenoid was found to increase drastically with the highest at 150 ppm carotenoids were also found to increase well with the hormone treatment. Cag *et al*. (2009) reported that SA treatment induced chlorophyll in exist cotyledons. High concentration such as 150 ppm SA retarded the chlorophyll level (Cag *et al*., 2009). In contrast to findings, SA induced doss of chlorophyll was also reported (Li *et al*., 1992).

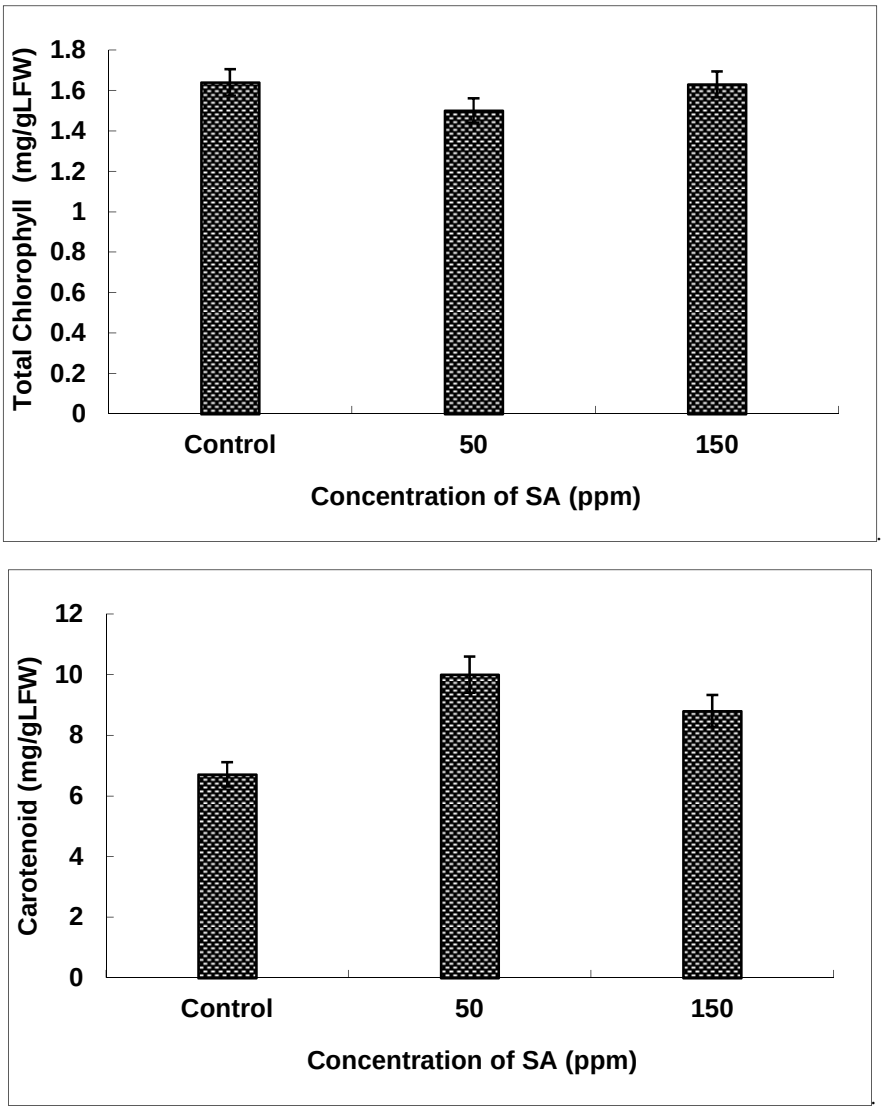


Fig. 1 Typical change in total chlorophyll and carotenoid content of *Vigna* treated with various concentrations of salicylate. The salicylate was sprayed onto 30 days old seedlings. The values are an average of 5 independent measurements. Mean ± SE, n = 5

Soybean plants show increased pigment content and photosynthesis treated with SA (Zhao *et al*., 1995). SA application activates the metabolic consumption of soluble sugar to form new cell constituents as a mechanism to stimulate the growth of plants proposed a decreased trend in soluble sugar level, upon SA foliar spray. SA is necessary for inducing antioxidant defenses and maintaining redox homeostasis in cells. Excessive accumulation of SA induces programmed cell death resulting in hypersensitive reaction to stress (Mateo *et al*., 2006).

Effect of SA on biochemical composition

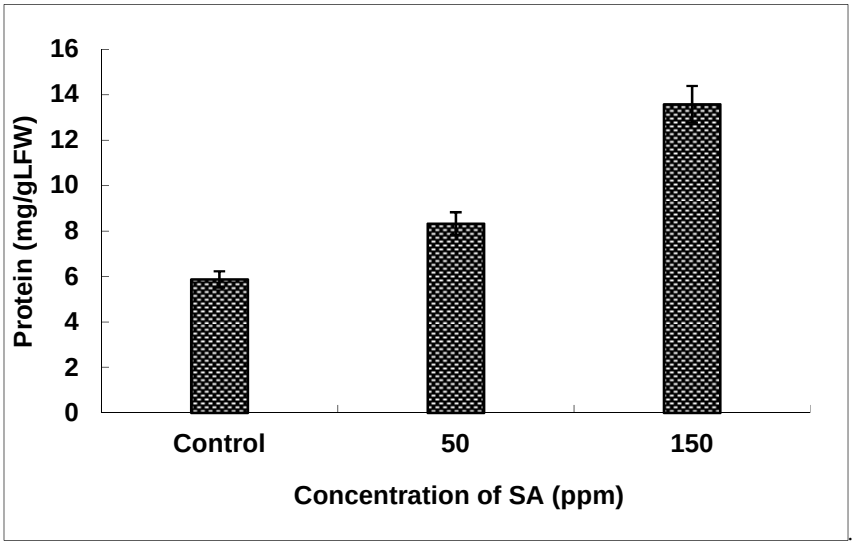
Foliar spray of *Vigna* seedlings with 50, 100 and 150 ppm of SA showed significant changes in the biochemical components in which both concentrations lowered on increase in all the parameters. Thus SA proved the growth hormones.

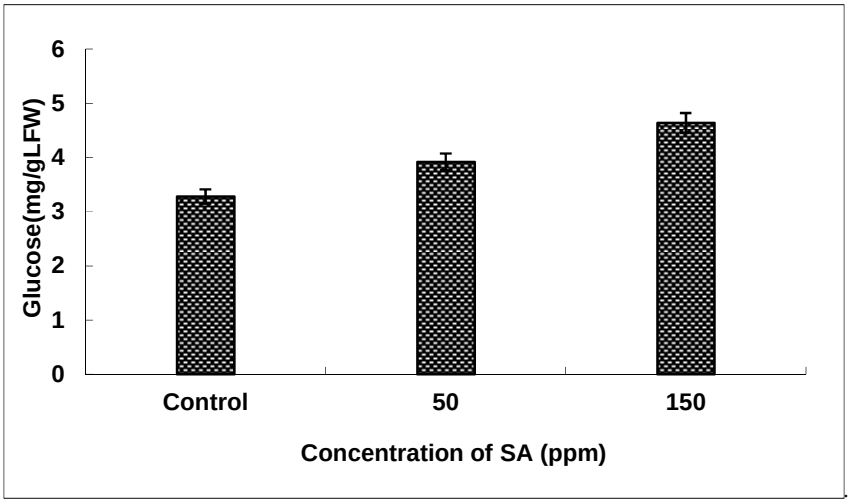
SA promotes some physiological processes whereas inhibiting others depends upon concentration, plant species, development stages and environmental conditions (Ding and Want, 2003; Mateo *et al*., 2006).

Besides photosynthetic pigments, other metabolites such as total sugar, soluble protein were measured in *Vigna* seedlings exposed to various concentration of SA. A gradual increase in both total sugar and soluble protein level was noticed compared to the untreated control. Similar observation was reported by Palavan-unsal *et al*., 2002; Cag *et al*., 2009) the magnitude of increase was more than that of Cag *et al*. (2009).

Effect of SA on NR activity

The measure of *in vivo* NR activity to assess the nitrogen metabolism status exhibits a better response with SA. With increase in SA concentration, the level of NR activity get increased up to 150 ppm. Thereafter, it decreased indicating the optimal SA concentration to be around 150 ppm for maximum vegetative growth.





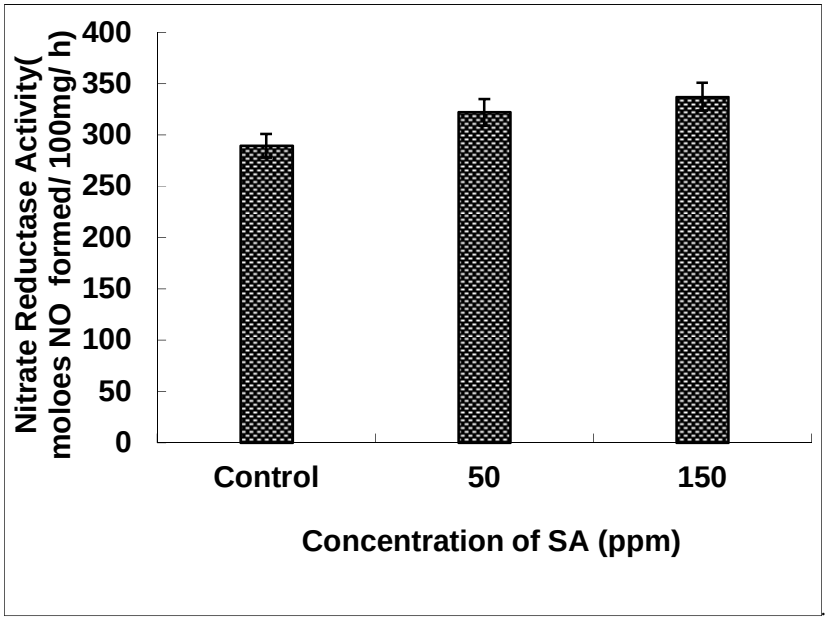


Fig.12 Typical changes in protein, glucose and NR activity content of *Vigna* treated with various concentrations of salicylate. The salicylate was sprayed onto 30 days old seedlings. The values are an average of 5 independent measurements. Mean ± SE, n = 5

CONCLUSION

SA has a good potential in improving accumulation of Biochemical composition. The concentrations of 100 and 150ppm of SA give the best results. So, the farmers may be advised to make up of SA for improving biomass and alkaloid content in *Vigna mungo.*

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