



Research Paper

STUDIES ON JASMONATE AND SALICYLATE COMBINED TREATMENT ON THE VEGETATIVE GROWTH AND PHOTOSYNTHETIC PIGMENT COMPOSITION IN *Vigna unguiculata* (L.) Walp

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Abstract

In the present work, an attempt was made to analyze the effects of phytohormones like Jasmonate and Salicylate given as a combined foliar spray to the intact seedlings of cowpea. The effects were analyzed in terms of vegetative growth and Photosynthetic pigment. The concentrations of the Jasmonate and Salicylate were 0.5 μM , 1.0 μM , 1.5 μM and 2 μM . The foliar spray was given once early in the morning. Combined hormonal foliar spray of the caused more amount of nodulation in the roots of *Vigna* seedlings as compared to control. More number of trifoliolate leaves was developed due to combined hormonal treatment especially at higher concentrations. Among the concentrations tested for maximum growth 2 μM of both the hormones proved to be at best when compared to individual treatment. Foliar application of both the hormones as combined mixture resulted in increase of shoot fresh weight in *Vigna*. Significant increase in dry weights of roots indicates the biomass partitioning influenced by Jasmonate and Salicylate. Thus the combination of JA and SA proved to be beneficial in *Vigna unguiculata* by promoting not only morphological responses but also photosynthetic pigment.

INTRODUCTION

Hormones also determine the formation of flowers, stems, leaves, the shedding of leaves, development and ripening of fruit. Hormones are vital to plant growth without which plants would be mostly a mass of undifferentiated cells. The study of plant hormones and the genes that control their synthesis, transport and downstream effects has identified many new tools for agricultural improvements. In addition to the

conventional phytohormones like auxin, gibberellin, cytokinin, ethylene and abscisic acid, hormones such as salicylic acid (SA) and jasmonic acid (JA) also play a major role in disease resistance. Jasmonates are one of the newest plant growth regulators which cause decrease in damages due to environmental stresses on plant system (Wang, 1999). Jasmonates occur in many plant species and are involved in various physiological processes (Creelman and Mullet, 1995; 1997). Jasmonates are hormones because they elicit cellular responses at low concentrations distant from their site of synthesis. SA, in particular, influences seed germination, seedling establishment, cell growth, respiration, stomatal closure, senescence-associated, gene expression, responses to abiotic stresses, basal thermotolerance, nodulation in legumes and fruit yield (Clarke *et al.*, 2004; Klessing and Malamy, 1994; Mateo *et al.*, 2004). Salicylic acid and Jasmonic acid are essential compounds in the pathogen and wound-signaling pathways accompanying induced expression of acidic and basic PR protein genes respectively. The phytohormone salicylate is a small phenolic compound that functions as an important signaling molecule during plant immunity (Vlot *et al.*, 2009).

MATERIAL AND METHODS

Procurement of seeds

Certified seeds of *Vigna unguiculata* (L.)Wilczek was procured from Tamilnadu Agricultural Research Station, Kovilpatti.

Cultivation of seedlings

The viable seeds were soaked in distilled water for overnight and allowed to germinate. The percentage of germination was nearly 85%. Seedlings were raised in earthen pots (125 x 25 cm) filled with a mixer of red soil, black soil and sand (in the ratio of 2:2:1). Twenty seeds were sown at equal distances at a depth of 2cm in each pot.

Salicylate and Jasmonate Treatment

Jasmonic acid and Salicylic acid was obtained from Sigma chemical Co., (St. Louis, U.S.A) and Merck Specialities Private Limited, Mumbai. SA & JA was initially dissolved in 100 µl of acetone, ethanol respectively and concentrations of 0.5 µM to 2 µM were made up with distilled water containing 0.02% Tween 20. SA, JA and combined SA + JA foliar application of *Vigna unguiculata* (L.)Wilczek seedlings at the fully developed trifoliate stage (3 week old seedlings) Control plants were sprayed with equal volume of sterilized distilled water. The experiment had 3 treatments. 2 week old *Vigna unguiculata* (L.)Wilczek plants of similar size were selected and divided into three groups. Group 1: healthy control, plants sprayed with water; Group 2: Plants treated with 0.5 µM to 2 µM SA; Group 3: Plants treated with 0.5 µM to 2 µM JA; Group 4: Plants treated with 0.5 µM to 2 µM SA +JA.

Estimation of pigments

The procedure of extracting of photosynthetic pigments from freshly harvested leaves was the same as that of Lingakumar and Kulandaivelu (1996). The amount of Chla, Chlb, total Chlorophyll and carotenoids was measured at 662, 645 and 470 nm respectively using a Hitachi U-200 double beam spectrophotometer and estimated using the formulae of Wellburn and Lichtenthaler (1984).

RESULT AND DISCUSSION

Changes in morphological parameters

Jasmonate spray given to two weeks old seedlings of *Vigna unguiculata* showed prominence in growth parameters such as root and shoot length, shoot and root fresh weights, dry weights and nodulation. Similarly SA treatment was also effective but significant morphological changes were noted under Jasmonate, Salicylate and JA+SA combined treatment. Such an observation of changes in root length was reported by Staswick *et al.* (1992). They observed inhibition of root length by MeJA treatment in a mutant of *Arabidopsis*.

MeJA generally inhibited root and shoot growth in *P. nil*, although a very low concentration (10^{-7} M) enhanced elongation (Maciejewska and Kopcewicz, 2002). Four or six applications of MeJA to 5-year-old peach (*Prunus persica* L. Batsch) trees reduced shoot growth, and 14 applications of MeJA reduced branch length, canopy density, leaf area and leaf FW in *Malus baccatam* and *schurica* (Janoudi and Flore, 2003).

The changes in vegetative growth parameters of *Vigna* exposed to Jasmonate, Salicylate and Jasmonate + Salicylate foliar spray at different concentrations. Typical changes in morphology of the seedlings exposed to JA, SA and JA+SA treatment. Combined hormonal foliar spray of the caused more nodulation in *Vigna* seedlings as compared to control. More number of trifoliolate leaves was developed due to combined hormonal treatment especially at higher concentrations.

Shoot length

The changes in shoot length of *Vigna* seedlings exposed to individual Jasmonate, Salicylate treatment and combined JA and SA treatment are shown in Fig. 1 (a). The data are given for different concentration of hormones of plant growth. Although there was no appreciable increase in this parameter, a significant increase was noticed in overall growth. Among the concentrations tested for maximum growth 2 μ M of both the hormones proved to be at best when compared to individual treatment.

Root length

The changes in root length of *Vigna* seedlings exposed to individual Jasmonate and Salicylate treatment and combined JA & SA treatment are shown in Fig. 1 (b). The data are given for different concentration of hormones of plant growth. Although there was no appreciable increase in this parameter, a significant increase was noticed in

overall growth. Among the concentrations tested for maximum growth 2 μM of both the hormones proved to be at best when compared to individual treatment.

Shoot and Root fresh weights

The changes in shoot and root fresh weight of *Vigna unguiculata* exposed to various concentration of JA, SA and JA+SA. Foliar application of both the hormones as combined mixture resulted in increase of shoot fresh weight of growth in *Vigna*. Similarly, fig.1 (c,d) show the changes in fresh weight of roots of seedlings that have received hormonal treatment. As compared to shoot, root fresh weight was significantly increased by hormonal treatment.

Shoot and Root dry weights

The changes in shoot and root dry weights of *Vigna unguiculata* exposed to various concentration of JA, SA and JA+SA are shown in fig 1 (e,f). Foliar application of both the hormones as combined mixture resulted in increase of shoot dry weight of growth in *Vigna*. Similarly, Fig 1(e,f) show the changes in dry weight of roots of seedlings that have received hormonal treatment. As compared to shoot, root fresh weight was significantly increased by hormonal treatment

Pigment composition

The photosynthetic pigments included Chl *a*, *b*, total Chl and carotenoids. *Vigna unguiculata* sprayed with different concentrations (0.5, 1.0, 1.5 and 2.0 μM) of JA, SA and JA+SA. Irrespective of the concentrations there was a hike in Chl content especially Chl *a*. Similarly, both JA and SA induced an increase in Chl *b* also. The combination of JA and SA favored an increase in carotenoid content as compared to individual hormone Fig.1 (g,h,i,j). Jasmonic acid and its related compounds have been shown to stimulate the accumulation of plant pigments. Jasmonate, suggest chlorophyll increase, have already been reported to be effective in greening *Chlorella vulgaris* (Czerpak *et al.*, 2006).

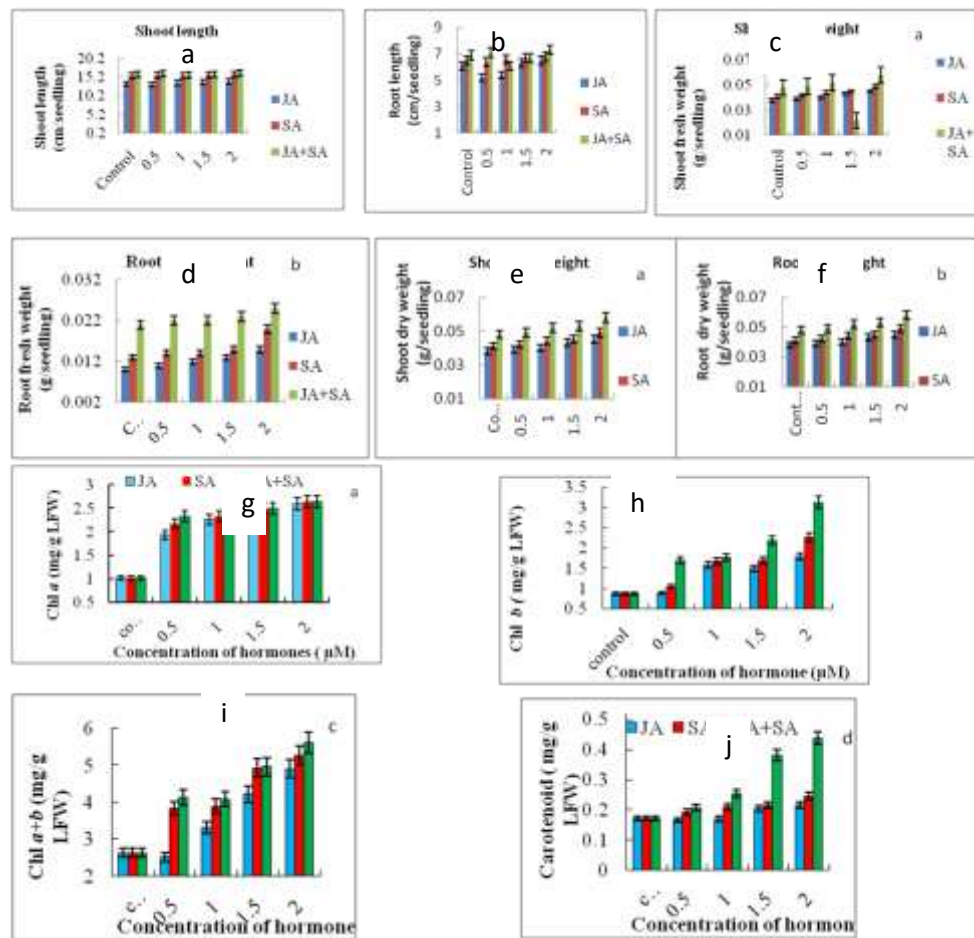


Fig.1 Effect of different concentrations of Jasmonate, Salicylate and combined JA and SA foliar spray on the Vegetative growth and photosynthetic pigment composition of *Vigna unguiculata* L. seedlings. Each value is an average of 3 independent measurements.

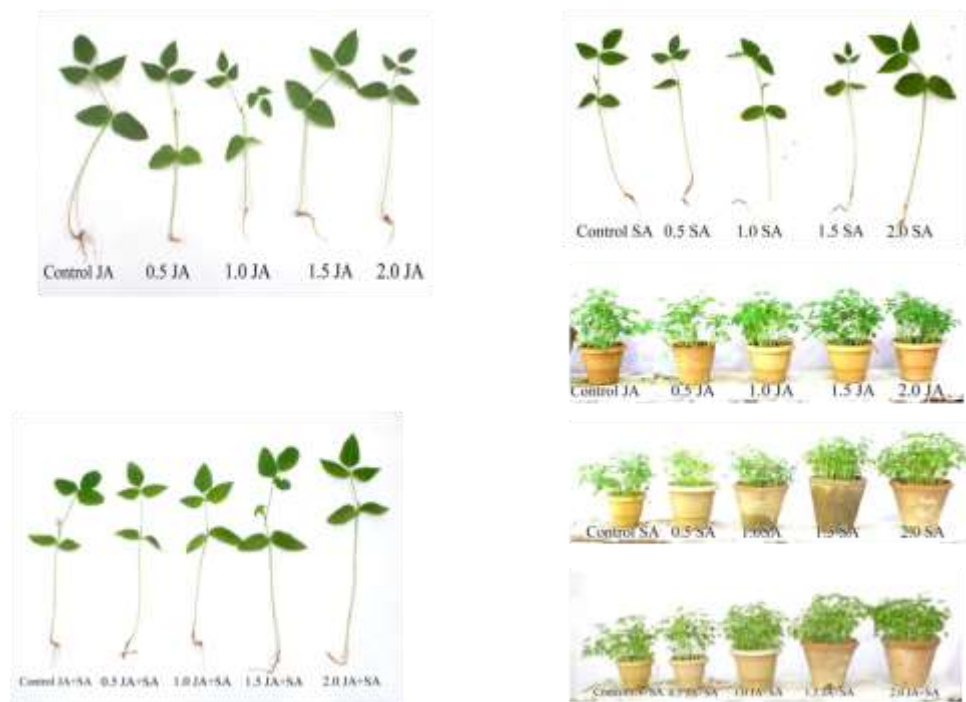


Fig. 2 Typical changes in morphology of *Vigna unguiculata* L. seedlings exposed to various concentrations of Jasmonate, Salicylate and Jasmonate + Salicylate foliar spray.

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