INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com Volume-3, Issue-4, Oct-Dec-2012 Coden : IJABPT Copyrights@2012
ISSN : 0976-4550

Received: 07th Oct-2012 *Revised: 13th Oct-2012* *Accepted: 14th Oct-2012*
Research Article

PHYSIOLOGICAL STUDIES OF *ARACHIS HYPOGAEA* L. UNDER THE INFLUENCE OF SULFOSALICYLIC ACID

Jadhav S. H.and Bhamburdekar S. B.

jsunita08@rediffmail.com

P. G. Department of Botany, Plant Physiology Section, Krishna Mahavidyalaya, Rethare Bk., Dist. Satara, 415 110 (MS) India.

ABSTRACT: A study was carried out on growth, photosynthetic pigments, and yield attributing and seed characteristics of *Arachis hypogaea* L. (Cv. SB-11). The treatments comprised of different concentrations (5, 50, 100 and 200 ppm) of Sulfosalicylic acid (SSA). The results showed that 50 ppm concentration of foliar applied SSA effectively promoted the growth parameters, photosynthetic pigments (chl a, chl b, total chl, carotenoids and chlorophyll stability index), yield parameters and seed protein and seed oil contents of groundnut. Similarly significant decrease in severity of tikka disease was reported with 50 ppm SSA. SSA 100 ppm profound better influence on the number of branches, height of plant and the shelling percentage. It could be concluded that SSA proved to be beneficial in promoting plant growth and yield and in inducing systemic resistance against tikka disease in groundnut.

Key Words: *Arachis hypogaea* L., Sulfosalicylic acid, Photosynthetic pigments, Yield attributes, Disease index

INTRODUCTION:

The phenolic compound salicylic acid (SA) is an important plant hormone (Hayat *et al.*, 2007). SA and its derivatives have been reported to be involved in various physiological and biochemical processes in plants (Khan *et al.*, 2003 and Cag *et al.*, 2009). As SA is an important signaling molecule, it plays an important defensive role in plants against various biotic and abiotic stresses (Sayeed *et al.*, 2011 and Idress *et al.*, 2011). 5-sulfosalicylic acid (SSA) is one of the derivatives of SA. Although SA and its related compounds are well known for inducing growth and disease resistance, little is known about SSA effects. Senaratna *et al.*, (2003) studied the role of SSA in multiple stress tolerance in plants. There is an evidence of involvement of SSA in increasing vase life of gladiolus cut flowers (Ezhilmathi, 2007). Tuna *et al.*, (2007) have been reported the influence of SSA on growth, nutrient uptake and activities of antioxidant enzymes of salinity stressed maize.
Keeping the above points in view, the present investigation was undertaken to know the role of SSA in growth of groundnut.

MATERIAL AND METHODS

The seeds of groundnut cultivar SB-11 were obtained from agricultural research station, Karad. The experiment was laid out in Randomized Complete Block Design (RCB) with three replications. Seeds were sown in 5×3 m field plots. At the age of 30 days, the plants were sprayed with different concentrations (5, 50, 100 and 200 ppm) of SSA as a foliar spray @ 40-50 ml/plant in 3 equal doses at 4 days interval. The plants receiving foliar sprays of distilled water served as control. The following parameters were analyzed at the end of treatments:

Morphometric Parameters

Number of branches, Number of leaves, Height of Plant, Leaf area, Fresh weight, Dry weight.

 Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

Disease Index

The disease severity was recorded at weekly intervals as per the modified scale given by Subrahmanyam (1990).

Growth Parameters:

Relative Growth Rate (RGR) (Blackman, 1919), Absolute Growth Rate (AGR) (West *et al.*, 1920) and Net Assimilation Rate (NAR) (Gregory, 1926) were recorded as per the standard formulas

Yield Parameters:

Number of gynophores, Number of pods per plant and Shelling percentage.

Biochemical Analysis:

The chlorophyll contents were determined following the method of Arnon (1949). The carotenoids were calculated by using formula of Kirk and Allen (1965). The chlorophyll stability index (CSI) was determined from total chlorophyll contents of known quantity of fresh leaf material and of leaf material kept in oven at $60^{o}C$ for 2 hrs.

Seed Oil Content:

Groundnut seeds were ground and oil was extracted for 8 h with diethyl ether in soxhlet apparatus. Then, the solvent was completely removed under reduced pressure in a rotary evaporator. Oil percentage was determined by weigh difference. The oil content was estimated by Nuclear Magnetic Resonance (NMR) Spectrophotometer against a standard reference sample.

Seed Protein Content:

Protein content of groundnut seeds was determined by using the Kjeldahl N analysis method by taking 4-5 grams of seed samples from each treatment unit. The samples were ground and stored in air tight plastic bottles. Total nitrogen concentration (%) was worked out by using micro Kjeldahl analysis method (Nelson and Sommers, 1980).

RESULTS AND DISCUSSION

The study of growth parameters is an important criterion to understand the pattern of crop growth and development. The results of present investigation revealed favorable influence of SSA on morpho-physiological and biochemical attributes of groundnut. The effect of different concentrations of SSA on morphometric- parameters of groundnut are given in Table 1. All the studied morphometric- parameters registered induction over control. The maximum number of branches and highest total height of plant was noticed with foliar spray of 100 ppm SSA. Whereas SSA 50 ppm significantly increased number of leaves, leaf area, fresh and dry weight per plant. Table 2 showed the influence of SSA on growth parameters viz., RGR, AGR and NAR. In comparison to all the applied treatments 50 ppm SSA effectively enhanced RGR and AGR on fresh weight basis and NAR while increased RGR and AGR on dry weight basis was noticed with 100 ppm treatment of SSA. Several reports have been emphasized the role of SA and its derivatives on morphological and growth parameters of plants (Mendoza *et al.*, 2002; El-Tayeb and Ahmad, 2010 and Abdi *et al.*, 2011). Mendoza *et al.*, (2002) found that treatment of pepper- seeds with SA and SSA (10^{-4} M) increases leaf number, plant height, fresh and dry weight. The increased growth parameters might be the consequence of significant increase in leaf area and fresh and dry weight of plant.

Yield is the combined manifestation of various morphological, growth and physiological parameters in crop. The yield components such as number of gynophores, number of pods and shelling percentage greatly influenced in response to SSA (Table 3). The results revealed highest number of gynophores and pods per plant with 50 ppm SSA and higher shelling percentage in 100 ppm SSA treated plants. Several reports have been achieved on the effect of exogenous application of SA on the yield attributes in plants. It has been reported that SA improved number of pods per plant, pod weight, and harvest index in mungbean (Singh and Kaur, 1980), cheena millet (Datta and Nanda, 1985) and pear (Kumar *et al.*, 1997).

Leaf spot disease-tikka is one of the major and most common serious airborn disease of groundnut that contributes the severe yield loss of 50-70% and affects the seed quality (Porter *et al.*, 1982 and Subrahmanyan *et al.*, 1984). The application of SSA very efficiently reduced severity of tikka disease caused by *Cercospora arachidicola* Hori. (Table 3). SSA 50 ppm was found to be reduced tikka disease index to 50% over control. Earlier it has been found that the application of SA and its functional analogs such as 2, 6 dischloroisonicotinic acid (INA), benzothiadiazole 5-methyl ester (BTH) induces expression of PR-genes and resistance against viral, bacterial, oomycete and fungal pathogens (Pasquer *et al.*, 2005 and Makandar *et al.*, 2006). It is clear that the application of 50 ppm SSA is very effective in reducing tikka disease in groundnut which might produce higher biomass and yield of crop.

All the applied treatments of SSA positively influenced photosynthetic pigments such as chl a, chl b, total chlorophyll and carotenoid contents and CSI (Fig 1-3). In particular SSA 50 ppm had recorded noteworthy induction in photosynthetic pigments and CSI which was followed by 5 and 100 ppm SSA. Our results show close conformity with findings of Tuna *et al.,* (2007). They stated that 1 and 2 mM SSA caused induction in contents of total chlorophylls and carotenoid levels. Earlier similar results also reported by Agarwal *et al.*, (2005). There is not sufficient information available on how SA and its analogs influences CSI and what changes it brings about photosynthetic pigments and subsequent plant growth and productivity. The significantly increased CSI with 50 and 100 ppm SSA correlates with the chlorophyll contents. Thus high CSI due to SSA treatments indicate that it can help groundnut crop to increase photosynthetic rate and dry matter accumulation.
Influence of SSA on seed protein and oil content of groundnut are given in Fig 4-5. Among all the applied treatments a noticeable induction in oil and protein contents of groundnut seeds were recorded with 50 ppm SSA. Foliar application of SA induced the protein content of green gram seeds (Rao *et al.*, 1998). In contrast to it decreased levels of soluble proteins has been reported by Ezhilmathi *et al.,* (2007) in cut gladiolus flowers kept in vase solution containing 5- SSA. It is clear that the treatments of SSA might be involved in improving nutritive quality of groundnut seeds thereby inducing soluble proteins and oil content.

Table 1: Effect of SSA on Morphometric Parameters of Groundnut

Treatment (ppm)	Number of Branches	Number of Leaves 55DAS	Height Pl^{-1} 55DAS	Leaf Area (cm^2 pl^{-1})	Fresh Wt Pl^{-1}(cm)	Dry Wt Pl^{-1} (cm)
Control	5.0 ± 0.0	126.66 ± 0.3	36.50 ± 0.60	66.82±0.95	17.69±0.58	9.49 ±0.045
SSA 5	5.0 ± 0.0	158.67 ± 0.66	37.40 ± 0.30	114.08±0.9	25.95±0.78	12.49±0.18
SSA 50	5.0 ± 0.0	182.0 ± 1.15	37.10 ± 0.50	123.97±0.0	29.26±0.50	12.84±0.50
SSA 100	5.66 ± 0.3	166.0 ± 1.1	54.70 ± 0.50	117.60±0.0	26.54±0.34	12.61±0.34
SSA 200	5.0 ± 0.0	149.33 ± 0.66	32.23 ± 3.7	108.26±1.3	25.76±0.49	10.74±0.49

Table 2: Effect of SSA on Growth Parameters of Groundnut

Treatment (ppm)	RGR g g^{-1} day^{-1}		AGR g g^{-1} day^{-1}		NAR g dm^2 day^{-1}
	Fresh Wt basis	Dry Wt basis	Fresh Wt basis	Dry Wt basis	
Control	0.0805	0.0803	0.250	0.249	0.0228
SSA 5	0.104	0.0900	0.406	0.302	0.0243
SSA 50	0.109	0.0870	0.448	0.285	0.0265
SSA 100	0.107	0.0912	0.430	0.310	0.0250
SSA 200	0.106	0.0789	0.423	0.242	0.0257

Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

Table 3: Effect of SSA on Yield Attributes and Disease Index of Groundnut

Treatment (ppm)	No. of Gynophores Pl^{-1}	No. of pods Pl^{-1}	Shelling Percentage	Disease Index (%)
Control	127	25. 50	69.08	30.0
SSA 5	169	44. 50	74.64	24.5
SSA 50	173	46. 75	74.97	15.1
SSA 100	170	45. 00	75.88	23.7
SSA 200	160	39. 50	73.75	17.0

Each value is mean of 3 determinations

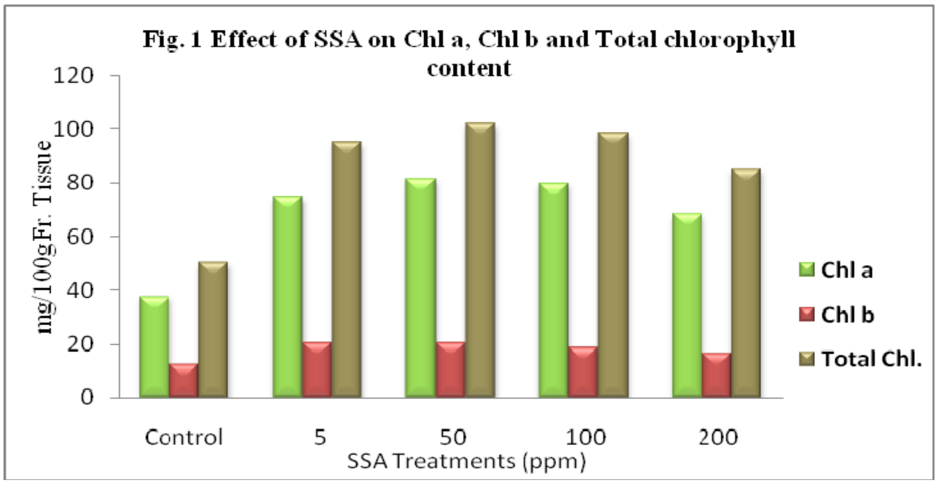

Fig. 1 Effect of SSA on Chl a, Chl b and Total chlorophyll content

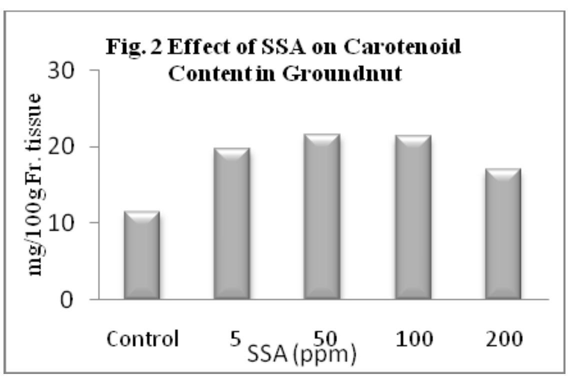

Fig. 2 Effect of SSA on Carotenoid Content in Groundnut

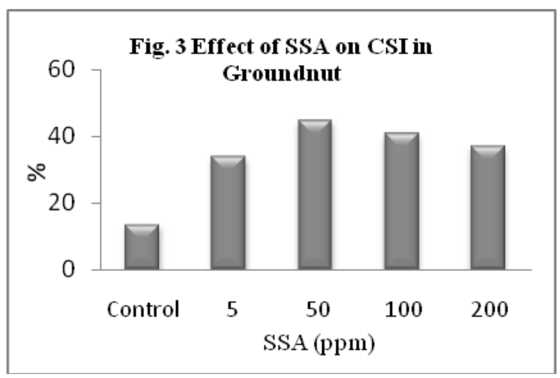

Fig. 3 Effect of SSA on CSI in Groundnut

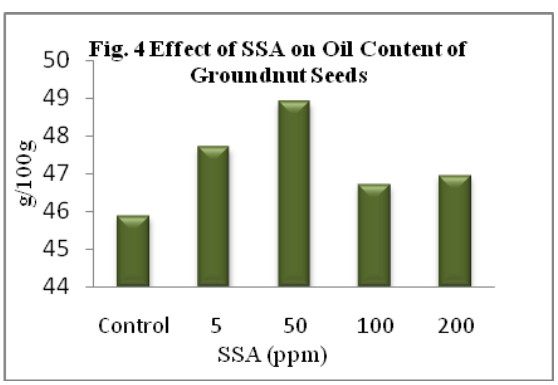

Fig. 4 Effect of SSA on Oil Content of Groundnut Seeds

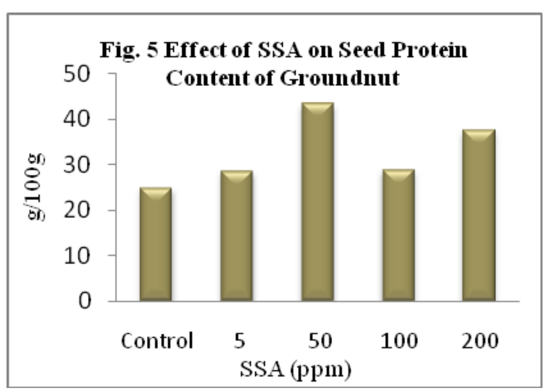

Fig. 5 Effect of SSA on Seed Protein Content of Groundnut

REFERENCES

Abdi G., M. Mohammadi and M. Hayat (2011). J. Biol. Envirom. Sci.: Vol. 5 (13) 31-35.

Agarwal S., R. K. Sairam, G. C. Srivastava and R. C. Meena (2005). Biologia Plant.: Vol. 49 541-550.

Arnon D. I. (1949). Plant Physiology: Vol. 25 1-25.

Blackman V. H. (1919). Annals of Botany: Vol. 33 353-360.

Cag S., G. Cevahir-oz, M. Sarsag and N. Goren-Saglam (2009). Pak. J. Bot.: Vol. 41(5) 2297-2302.

Datta K. S. and K. K. Nanda (1985). Indian Journal of Plant Physiology: Vol. 28 298-302.

El-Tayeb M. A. and N. L. Ahmed (2010). American Eurasian Journal of Agronomy: Vol. 3(1) 01-07.

Ezhilmathi K., V. P. Singh, A. Arora and R. K. Sairam (2007). Plant Gr. Regul.: Vol. 51 99-108.

Gregory F.C. (1926). Annals of Botany: Vol. 42 1-26.

Hayat S., B. Ali and A. Ahmad (2007). Salicylic Acid- A Plant Hormone. Dordrecht, the Netherlands.

Idrees M., N. Naeem, T. Aftab, M. M. A. Khan and Moinuddin (2011). Acta Physiol. Plant: Vol. 33 987 - 999.

Khan W., B. Prithviraj and D. L. Smith (2003). J. Plant Physiol., Vol. 160 485-492.

Kirk J. O. T. and R. L. Allen (1965). Arch. Biochem., Biophys. Viommun.: Vol. 21: 523-530.

Kumar P., S. P. Dube, V. P. Mani and V. S. Chauhan (1997). National seminar on plant physiology for sustainable Agriculture IARI, New Delhi: 69.

Makandar R., J. S., Essig, M. A. Schapaugh, H. N. Trick and J. Shah (2006). Mol. Plant Microbe Inter.: Vol. 19 123-129.

Mendoza A. B., F. R. Godina, V. R. Torres, H. R. Rodriguez and R. K. Maiti (2002). Crop Res.: Vol. 24 19-25.

Nelson D. W. and L. E. Sommers. (1980). J. AOAC: Vol. 63 770–779.

Pasquer F., E. Isidore, J. Zarn, and B. Keller (2005). Plant Mol. Biol.: Vol. 57 693-707.

Porter D. M., D. H. Smith and R. Rodriguez-Kabana (1982). American Peanut Research and Education Society, Pierce Printing Company: 326-410.

Rao G. H., A. Narayanan and G. Subbarao (1998). National Seminar on Role of Plant Physiology and Biotechnology in Agriculture and Industry.

Sayeed S., N. A. Anjum, R. Nazar, N. Iqbal, A. Masood and N. A. Khan (2011). Acta Physiol. Plant.: Vol. 33 877-886.

Senaratna T., D. Merrit, K. Dixon, E. Bunn, D. Touchell, K. Sivasithamparam (2003). Plant Growth Regul.: Vol. 39 77-81.

Subrahmanyam P., J. H. Williams, D. Mcdonald and R. W. Gibbons (1984). Ann. Appl. Biol.: Vol. 104 467-476.

Subramanyan P., P. V. Subbarao and P. M. Reddy (1990). 2nd Internationl Congress on the French Phytopathological Society, Montopellier, France.

Singh G. and M. Kaur (1980). Indian J. Plant Physiol.: Vol. 23 366 -70.

Tuna A. L., C. Kaya, M. Dikilitas, I. Yokas, B. Burun and H. Altunlu (2007). Plants Pak J. Bot.: Vol. 39 (3) 787-798.

West C., G. E. Briggs and E. Kidd (1920). New Physiologist: Vol. 19 200-207.