

## Influence of ethrel on quality parameters and yield of soybean

A.N. SAHANE, R. D. DEOTALE, S.A. MAHALE, SHANTI R. PATIL and P.P. SAWANT

Botany Section, College of Agriculture, Dr. P. D. K. V., Akola, Nagpur-440001, India.

Email : ashishagricos17@gmail.com

(Received : June 02, 2014 ; Accepted : February 16, 2015)

### ABSTRACT

A field experiment was conducted during *khariif* 2013-14 at farm of Botany section, College of Agriculture, Nagpur to study the influence of two foliar sprays of 100, 150, 200, 250 and 300 ppm ethrel at 30 and 45 DAS on quality parameters and yield of soybean. Data revealed that 200 ppm ethrel significantly increased leaf chlorophyll, leaf nitrogen, leaf phosphorus, leaf potassium content, seed protein and oil content and yield of soybean.

**Keywords:** Chemical and biochemical parameters, ethrel, soybean and yield

Soybean (*Glycine max* L.) is a miracle "Golden bean" of 21<sup>th</sup> century mainly due to its high protein (38-41%) content and oil content (19-21%) and is now making headway in Indian agriculture. In India it is mainly grown as oilseed crop. Among, oilseeds soybean ranks fifth in the world. The important soybean growing countries in world are America, Brazil, Argentina, China and India. The largest soybean producing state in India are Madhya Pradesh, Maharashtra and Rajasthan. In India Maharashtra having Second rank in production. Plant growth regulators are known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates thereby helping in effective flower formation, fruit and seed development and ultimately enhance productivity of the crops. Growth regulators can improve the physiological efficiency including photosynthetic ability and enhance the effective partitioning of assimilates from source and sink in the field crops (Solamani *et al.*, 2001).

Ethrel (2-chloroethylphosphonic acid) is a plant growth regulator reported to improve the productivity of pulse crop like soybean, cowpea, pigeonpea, mungbean by increasing the number of pods, seed weight and seed yield (Chandra 1985, Singh 1984, Yadav *et al.* 1980, Bora and Bohra 1989). The aim of present work was to study the influence of ethrel on quality parameters and yield of soybean.

A field experiment was conducted at the experimental farm of Botany section, College of Agriculture, Nagpur to study the influence of foliar sprays of ethrel on quality parameters and yield of soybean. The present investigation was undertaken during the *khariif* season of 2013-2014. The field experiment was laid out in Randomized block Design (RBD) with four replications consisting of six treatments

comprising of different concentrations of ethrel (100, 150, 200, 250 and 300 ppm) at 30 and 45 DAS. Plot size of individual treatment was gross 2.10 m x 2.20 m and net 1.5 m x 2.00 m. Seeds were sown at the rate of 75 kg ha<sup>-1</sup> by dibbling method at a spacing of 30 cm x 10 cm. Observations were recorded at different stages i.e. at 45, 60 and 75 DAS on chlorophyll content, leaf nitrogen, leaf phosphorus, leaf potassium content. Nitrogen content in leaves was estimated as per methods suggested by Somichi *et al.* (1972), phosphorus and potassium content from leaves were estimated as per method suggested by Jackson (1967). Chlorophyll from leaves was estimated by Colorimetric method as suggested by Bruinsma (1982). Nitrogen content in seed was analysed by Somichi *et al.* (1972) and the same was converted to crude protein. Oil content in seed was determined by Soxhlet's method as suggested by Sankaran (1965). Seed yield plant<sup>-1</sup>, plot<sup>-1</sup> was recorded after harvesting. Data were analysed by statistical method as suggested by Panse and Sukhatme (1954).

Leaf chlorophyll content Data regarding chlorophyll content were recorded at 45, 60, and 75 DAS. Significant variation was noticed at every stage of observation by the foliar sprays of ethrel. At 45 DAS chlorophyll content was significantly increased in treatment T<sub>4</sub> (200 ppm ethrel) followed by the treatments T<sub>3</sub> (150 ppm ethrel) and T<sub>5</sub> (250 ppm ethrel) in a descending manner when compared with treatment T<sub>1</sub> (control) and remaining treatments under study. Treatments T<sub>6</sub> (300 ppm ethrel) and T<sub>2</sub> (100 ppm ethrel) were found *at par* with treatment T<sub>1</sub> (control). At 60 DAS the treatment T<sub>4</sub> (200 ppm ethrel) followed by the treatment T<sub>3</sub> (150 ppm ethrel) noted significantly maximum chlorophyll content over treatment T<sub>1</sub> (control) and rest of the treatments under study. But treatments T<sub>5</sub> (250 ppm ethrel), T<sub>6</sub> (300 ppm ethrel) and T<sub>2</sub> (100 ppm ethrel) were found *at par* with treatment T<sub>1</sub> (control). At 75 DAS the treatment T<sub>4</sub> (200 ppm ethrel) followed by the treatment T<sub>3</sub> (150 ppm ethrel) was most effective in increasing chlorophyll content in leaves when compared with treatment T<sub>1</sub> (control) and rest of the treatments under study. Also, treatments T<sub>5</sub> (250 ppm ethrel) and T<sub>6</sub> (300 ppm ethrel) and T<sub>2</sub> (100 ppm ethrel) were found *at par* with treatment T<sub>1</sub> (control). Devi *et al.* (2011) studied the effect of foliar spray of growth regulators salicylic acid (50 ppm), ethrel (200 ppm) and cycocel (500 ppm) on soybean. They observed that ethrel at 200 ppm significantly increased chlorophyll content over control. Sharma and Sardana (2012) carried out a field

experiment to study the effect of foliar application of growth regulating substances i.e IAA, ethrel and mepiqyat chloride on groundnut and reported that the application of IAA at 5 ppm + ethrel at 25 ppm significantly increased chlorophyll content in leaves.

Data regarding leaf nitrogen content were recorded at 45, 60 and 75 DAS and found statistically significant. At 45 DAS nitrogen content was significantly more in treatment T<sub>4</sub> (200 ppm ethrel) followed by the treatment T<sub>3</sub> (150 ppm ethrel) when compared with treatment T<sub>1</sub> (control) and other remaining treatments under study. Treatments T<sub>5</sub> (250 ppm ethrel) and T<sub>6</sub> (300 ppm ethrel) were also noted significantly more nitrogen over treatment T<sub>1</sub> (control). While, treatment T<sub>2</sub> (100 ppm ethrel) was found at par with treatment T<sub>1</sub> (control). At 60 DAS nitrogen content was significantly maximum in treatment T<sub>4</sub> (200 ppm ethrel) followed by the treatment T<sub>3</sub> (150 ppm ethrel) when compared with treatment T<sub>1</sub> (control) and other treatments. Treatment T<sub>2</sub> (100 ppm ethrel) was found at par with treatment T<sub>1</sub> (control). At 75 DAS nitrogen content was significantly maximum in treatment T<sub>4</sub> (200 ppm ethrel) followed by the treatments T<sub>3</sub> (150 ppm ethrel) and T<sub>5</sub> (250 ppm ethrel) when compared with treatment T<sub>1</sub> (control) and rest of the treatments. Next to these treatments, treatment T<sub>6</sub> (300 ppm ethrel) was also found significant over T<sub>1</sub> (control). While, treatment T<sub>2</sub> (100 ppm ethrel) was found at par with treatment T<sub>1</sub> (control). Khan *et al.* (2008) conducted field experiment to study the effect of ethephon (ethrel) on mustard. They observed that ethrel increased the nitrogen (N) content in leaves.

Data on Leaf phosphorus content were recorded at four stages viz., 45, 60 and 75 DAS. Leaf area recorded at these stages gave significant results. At 45 DAS significantly more leaf phosphorus content was recorded in treatment T<sub>4</sub> (200 ppm ethrel) followed by treatment T<sub>3</sub> (150 ppm ethrel) when compared with treatment T<sub>1</sub> (control) and other treatments under study. Treatments T<sub>5</sub> (250 ppm ethrel) and T<sub>6</sub> (300 ppm ethrel) also showed their significance over treatment T<sub>1</sub> (control). While, treatment T<sub>2</sub> was found at par with treatment T<sub>1</sub> (control). At 60 DAS significantly

maximum leaf phosphorus content was recorded in treatment T<sub>4</sub> (200 ppm ethrel). Next to these treatment, treatments T<sub>3</sub> (150 ppm ethrel), T<sub>5</sub> (250 ppm ethrel) and T<sub>6</sub> (300 ppm ethrel) also gave significantly more phosphorus over treatment T<sub>1</sub> (control). Treatment T<sub>2</sub> (100 ppm ethrel) was found at par with treatment T<sub>1</sub> (control). At 75 DAS leaf phosphorus content was significantly maximum in treatment T<sub>4</sub> (200 ppm ethrel) followed by the treatment T<sub>3</sub> (150 ppm ethrel) when compared with treatment T<sub>1</sub> (control) and other rest of the treatments. Treatments T<sub>5</sub> (250 ppm ethrel), T<sub>6</sub> (300 ppm ethrel) and T<sub>2</sub> (100 ppm ethrel) also showed their significance over treatment T<sub>1</sub> (control).

Data on leaf potassium content were recorded at the three growth stage i.e. 45, 60 and 75 DAS gave significant variation. At 45 DAS significantly maximum leaf potassium content was observed in treatments T<sub>4</sub> (200 ppm ethrel) and T<sub>3</sub> (150 ppm ethrel) when compared with treatment T<sub>1</sub> (control) and rest of the treatments under study. Next to these treatments, treatments T<sub>6</sub> (300 ppm ethrel) and T<sub>2</sub> (100 ppm ethrel) also showed their significance over T<sub>1</sub> (control).

At 60 DAS significantly maximum leaf potassium content was observed in treatment T<sub>4</sub> (200 ppm ethrel) when compared with treatment T<sub>1</sub> (control) and rest of the treatments under study. Next to these treatments T<sub>3</sub> (150 ppm ethrel) and T<sub>5</sub> (250 ppm ethrel) also showed their significance over T<sub>1</sub> (control). While, treatments T<sub>6</sub> (300 ppm ethrel) and T<sub>2</sub> (100 ppm ethrel) were found at par with treatment T<sub>1</sub> (control). At 75 DAS significantly maximum leaf potassium content was observed in treatment T<sub>4</sub> (200 ppm ethrel) followed by T<sub>3</sub> (150 ppm ethrel) when compared with treatment T<sub>1</sub> (control) and rest of the treatments under study. Next to these treatments, treatment T<sub>5</sub> (250 ppm ethrel) and T<sub>6</sub> (300 ppm ethrel) also showed their significance over T<sub>1</sub> (control). While, treatment T<sub>2</sub> (100 ppm ethrel) was found at par with treatment T<sub>1</sub> (control). Mir *et al.* (2009) conducted a field experiment to study the effect of basal nitrogen application and foliar spray of ethrel (ethephon) on mustard. The results showed that foliar spray of ethrel significantly increased potassium (K) content in

**Table 1. Influence of foliar sprays of ethrel on chemical and biochemical parameters of soybean**

Treatments	Leaf chlorophyll (mg g <sup>-1</sup> )			Leaf nitrogen (%)			Leaf phosphorus (%)			Leaf potassium (%)		
	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS
T <sub>1</sub> (Control)	1.54	1.56	1.22	2.28	2.20	1.76	0.35	0.58	0.43	1.12	2.01	1.29
T <sub>2</sub> (100 ppm ethrel)	1.61	1.64	1.24	2.35	2.23	1.80	0.37	0.62	0.49	1.23	2.06	1.38
T <sub>3</sub> (150 ppm ethrel)	1.74	1.77	1.31	2.56	2.37	2.08	0.48	0.75	0.57	1.41	2.25	1.75
T <sub>4</sub> (200 ppm ethrel)	1.81	1.86	1.40	2.64	2.41	2.12	0.51	0.80	0.60	1.47	2.39	1.84
T <sub>5</sub> (250 ppm ethrel)	1.72	1.75	1.29	2.50	2.30	2.00	0.45	0.71	0.55	1.39	2.18	1.69
T <sub>6</sub> (300 ppm ethrel)	1.65	1.69	1.27	2.46	2.28	1.93	0.42	0.67	0.52	1.27	2.10	1.45
SE(m) ±	0.040	0.048	0.028	0.044	0.046	0.052	0.016	0.010	0.012	0.027	0.038	0.031
CD at 5%	0.115	0.140	0.080	0.127	0.133	0.149	0.048	0.031	0.034	0.078	0.110	0.089

**Table 2. Influence of ethrel on seed protein, oil content and yield of soybean**

Treatments	Protein content (%)	Oil content (%)	Seed yield plant <sup>-1</sup> (g)	Seed yield plot <sup>-1</sup> (kg)
T <sub>1</sub> (control)	33.92	14.06	5.20	0.52
T <sub>2</sub> (100 ppm ethrel)	34.61	14.28	5.63	0.56
T <sub>3</sub> (150 PPM ethrel)	37.98	16.86	6.36	0.64
T <sub>4</sub> (200 ppm ethrel)	38.35	17.91	6.61	0.66
T <sub>5</sub> (250 ppm ethrel)	37.44	15.82	6.24	0.62
T <sub>6</sub> (300 ppm ethrel)	35.69	14.63	5.87	0.59
SE(m) ±	0.972	0.391	0.238	0.023
CD at 5%	2.793	1.124	0.685	0.068

leaves of plants.

Data indicated that protein content was significantly increased in treatment T<sub>4</sub> (200 ppm ethrel) followed by the treatments T<sub>3</sub> (150 ppm ethrel) and T<sub>5</sub> (250 ppm ethrel) when compared with treatment T<sub>1</sub> (control). While, treatment T<sub>2</sub> (100 ppm ethrel) was found *at par* with treatment T<sub>1</sub> (control). Devi *et al.* (2011) investigated the effect of foliar spray of growth regulators salicylic acid (50 ppm), ethrel (200 ppm) and cycocel (500 ppm) on soybean. They observed that ethrel at 200 ppm significantly increased protein content in soybean. Pahwa (2013) conducted a field experiment to study the effect of plant growth regulator on pigeonpea. In present study ethrel at 100 µg ml<sup>-1</sup> significantly increased protein content in seeds of pigeonpea.

Maximum oil content in seed of soybean was recorded in the treatment T<sub>4</sub> (200 ppm ethrel) followed by the treatments T<sub>3</sub> (150 ppm ethrel) and T<sub>5</sub> (250 ppm ethrel) when compared with treatment T<sub>1</sub> (control) and remaining treatments under study. The treatments T<sub>6</sub> (300 ppm ethrel) and T<sub>2</sub> (100 ppm ethrel) were found at par with treatment T<sub>1</sub> (control). Devi *et al.* (2011) investigated the effect of foliar spray of growth regulators salicylic acid (50 ppm), ethrel (200 ppm) and cycocel (500 ppm) on soybean. They observed that ethrel at 200 ppm significantly increased oil content in soybean. Lone (2001) conducted a field experiment to study the effect of cycocel and ethrel along with nitrogen on mustard and found that ethrel with basal dose of N at 80 kg ha<sup>-1</sup> significantly increased oil content.

Significantly maximum seed yield plot<sup>-1</sup> was recorded in treatment T<sub>4</sub> (200 ppm ethrel) followed by treatments T<sub>3</sub> (150 ppm ethrel) and T<sub>5</sub> (250 ppm ethrel) when compared with control and remaining treatments under study. While, treatments T<sub>6</sub> (300 ppm ethrel) and T<sub>2</sub> (100 ppm ethrel) were found at par with T<sub>1</sub> (control).

The use of plant hormone may prove its potential as it has been found to enhance growth and productivity of the crop plants. It also improve the crop manipulating source-sink relationship at pod development stage, several naturally occurring phytohormones ethylene influences about all aspects of plant growth and development as well as the induction of some plant defense responses. Ethrel

involved in diverse array of cellular, developmental and stress released processes in plants. It reduces the problem of pod shattering by restricting the flower and pod abortions, Mir *et al.* (2010). Devi *et al.* (2011) conducted experiment to study the effect of salicylic acid, ethrel and cycocel (50, 200 and 500 ppm) on soybean and observed that ethrel at 200 ppm gave highest number of pods plant<sup>-1</sup>, 100 seed weight and seed yield ha<sup>-1</sup>.

Sharma and Sardana (2012) tried ethrel and mepiquat chloride as foliar spray on groundnut and observed that IAA at 7.5 ppm + ethrel 25 ppm increased pod yield.

## REFERENCES

- Bora KK and Bohra SP. 1989. Effect of ethephon on growth and yield of *Glycine max* L. Comparative physiology and ecology, 14(2): 74-77.
- Bruinsma J. 1982. A comment on spectrophotometric determination of chlorophyll. Bio-chemistry, Bio-Physics, Acta. 52: 576-578.
- Chandra, S. 1985. Effect of growth regulators in relation to date of sowing on the growth and yield of soybean cultivars. M.Sc. (Agri) thesis (unpublished) submitted to Punjab Agricultural University, Ludhiana.
- Devi KN, Vyas AK, Singh MS and Singh NG. 2011. Effect of bioregulators on growth, yield and chemical constituents of soybean (*Glycine max*). Journal of agricultural and science. 3(4): 151-159.
- Jackson ML. 1967. Soil Chemical analysis, Printice Hall of India Pvt. Ltd. New Delhi, pp. 25-28.
- Khan NA, Mir MR, Nazar R and Singh S, 2008. The application of ethephon (an ethylene releaser) increases growth, photosynthesis and nitrogen accumulation in mustard (*Brassica juncea* L.) under high nitrogen levels. Plant Biology. 10: 534-538.
- Lone NA. 2001. Studies an effect of cycocel and ethrel in association with nitrogen on growth and metabolism of mustard under non irrigated condition. Ph.D. thesis submitted to Aligarh Muslim University, Aligarh, India.
- Mir MR, Khan NA, Lone, NA, Payne WA, Mir AH, Hassan A and Ahmed V, 2009. Effect of basal nitrogen application and foliar ethephon spray on morpho-physiological and productivity of mustard (*Brassica juncea* L. Czern and Cross). Applied biological research. 11(2): 53-58.
- Mir MR, Mobin M, Khan NA, Bhat MA, Lone NA, Bhat KA, Razvi SM, Wani SA, Wani N, Akhter S, Rashid S, Masoodi NH, Payne WA and Wani AH. 2010. Crop response to interaction between ethylene sources and nitrogen with special reference to oilseed crops. J of Phytology 2(10): 23-33.
- Pahwa K. 2013. Effect of plant growth regulators on manipulation of source-sink relationships in pigeonpea. Ph. D. (Agri.) thesis (unpublished) submitted to PAU, Ludhiana.
- Panase VG and Sukhatme PV, 1954. Statistical methods for agriculture workers. ICAR, New Delhi. pp. 107-109.
- Sankaran A. 1965. A Laboratory manual of Agriculture Chemistry Asia Published Bombay. pp. 258.
- Shafeek MR, Nagwa MK, Hassan, Singer SM and Nadia HM EL-Greadly. 2013. Effect of potassium fertilizer and foliar spraying ethrel on plant development, yield and bulb quality of onion plants (*Allium cepa* L). Journal of applied science and research. 9: 1140-1146.

Sharma P and Sardana V. 2012. Effect of growth regulating substances on the chlorophyll, nitrate reductase, leghaemoglobin content and yield in groundnut (*Arachis hypogea*). An international quarterly journal life science 7(1): 13-17.

Singh S. 1984. Effect of dates of sowing and growth regulators on growth and yield of mung. M.Sc. (Agri) thesis submitted Punjab Agricultural University, Ludhiana.

Solamani A, Sivakumar C, Anbumani S, Suresh T and Arumugam K. 2001. Role of plant growth regulators on rice production. A

review agricultural revolution 23: 33-40.

Somichi Y, Doughlus SY and James AP. 1972. Laboratory manual. Physiological studies in rice analysis for total nitrogen (organic N) in plant tissue. The inter. Research Institute Los Banos, Languna, Phillipine : II.

Yadav RBL, Verma OPS and Sartri JA. 1980. Note on the effect of growth regulators on seed yield of cowpea. Indian Journal of Plant Physiol. 18: 135-139.