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Role of Growth Stimulant in the Morphological Traits of Soybean

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Abstract: Effect of different concentrations of IAA applied at three stages of plant growth i.e., 15 days after emergence, at flowering and at seed filling was studied. A linear trend in the increase of Absolute Growth Rate (AGR) of shoot at all concentrations was observed which was maximum at 10 ppm. AGR of root was maximum at 5 ppm concentration. AGR at 0 ppm was minimum. AGR of shoot was linearly affected at different stages and maximum at 15 days after emergence stage. Relative Growth Rate (RGR) of shoot has a positive response to 10 ppm concentration at vegetative stage. While RGR of root was stimulus towards 15 ppm concentration. RGR of shoot and root were maximum at seed filling and 15 days after emergence stages respectively.

Key words: Indole acetic acid, growth, soybean

Introduction

Soybean is the most important oil and protein crop throughout the world. The world production of edible oils consists of 30.3 percent soybean. In Pakistan nearly 80 percent of the soybean is grown in NWFP (Hatim and Abbasi, 1994). The edible oil requirement of the country in 1990-91 was 1262 thousand tones, while domestic production was only 338 thousand tones, only 30 percent of the total requirement, hence edible oil worth Rs. 10,025.2 million was imported by Pakistan (Hatim and Abbasi, 1994). To avoid dependance on import it is indispensable to exploit our natural resources and boost the yield of soybean and other oil seed crops. Keeping in view the source-sink manipulation, a trial was carried out to see the role of growth regulator (IAA) on the morphological characteristics of soybean.

Materials and Methods

The proposed study was conducted in 1991 to investigate the effect of IAA on the growth of soybean. The soil of the experimental site was clay in nature with low phosphorous and organic matter contents. Therefor, before sowing a basic dose of DAP at 80 kg ha^{-1} was applied to the field. There were three replications in RCBD factorial arrangement having 12 treatments in each replication. The sub plot size was 3×4 m^2. Williams variety of soybean was sown at of 75 kg ha^{-1}. The detail of treatments is given as under:

Detail of treatments:

Growth regulator	Concentrations (ppm)	Growth Stages
Indole acetic acid	0, 5, 10, 15	15 days after emergence, at flowering, at seed filling stage

Absolute growth rate (AGR) and Relative growth rate (RGR) were calculated by digging out plants with roots from a space of 50 cm in each treatment. They were separated in to roots and shoots at every 15 days interval after emergence and were dried in oven and weighed accordingly. The AGR and RGR were calculated by the following formulas:

$$AGR = \frac{W2-W1}{T2-T1}$$

$$RGR = \frac{Ln\ W2-Ln\ W1}{T2-T1}$$

Where:
W = Phytomass dry wight T = Time
Ln = Natural log

All the cultural practices were adopted uniformly. The data were analyzed statistically according to the techniques of Steel and Torrie, (1980) and LSD test was applied to see the treatment differences.

Results and Discussion

Absolute Growth Rate (AGR): Generally AGR increased from about 0.5 g/50 cm day^{-1} to a peak at 75 days after emergence (end of vegetative growth) and then declined becoming negative at the end of season, lost more dry matter due to leaf abscission than it accumulated through photosynthesis. A linear trend in the increase of AGR of shoot at all concentrations was observed which was maximum at the end of vegetative growth. The AGR at 10 ppm concentration was maximum followed by 5 ppm. AGR at 0 ppm was minimum. After vegetative growth linear trend in the decrease of AGR of shoot at all concentrations was observed which become negligible at maturity stage. Figure 1(a,b) showed a curvilinear increase in AGR of root due to different concentrations of IAA. At 5 ppm concentration AGR of root was linearly increased up to 75 days after emergence. The AGR of shoot and root affected by different growth stages are reported in Fig. 1 (c, d). At different stages also a linear trend in the increase of AGR of shoot was observed. It was gradually increasing up to 75 days after emergence and became maximum at that stage. AGR at seed filling stage reached the maximum value. The proliferation of shoot was similar up to 75 days after emergence which might be attributed to the IAA spray at respective stage. After vegetative growth, linear trend in the decrease of AGR was observed. The AGR at all growth stages was linearly increased as the growth enhanced after reaching the vegetative cover. AGR increased from about 0.5 g/50 cm day^{-1} to a peak at 75 days after emergence and then declined becoming negative at the end of season, clearly shows that AGR is mainly dependent on vegetative growth. This implies that IAA is mainly effective during vegetative growth and the growth regulator easily penetrate, translocate and beneficially used by the plant for its growth and development. A linear trend in the increase of AGR of shoot at all concentrations and stages was observed while a curvilinear increase in AGR of root at different concentrations and stages was observed which revealed that IAA was mainly used by vegetative part (shoot). The concentrations of 10 and 5 ppm were mostly effective rather than 15 ppm and control treatment. This indicated that excessive concentrations as well as the deficiency

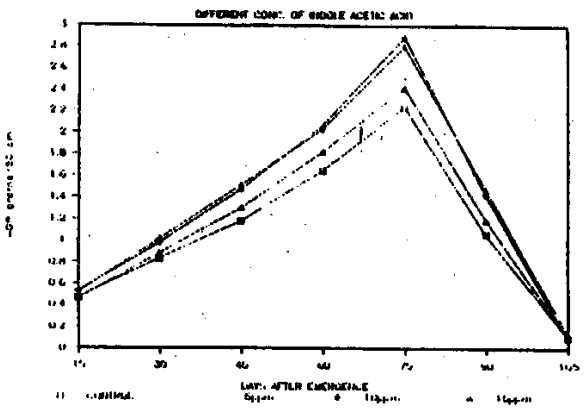

Fig. 1(a): AGR of Shoot as Affected By Different Conc of Indole Acetic Acid

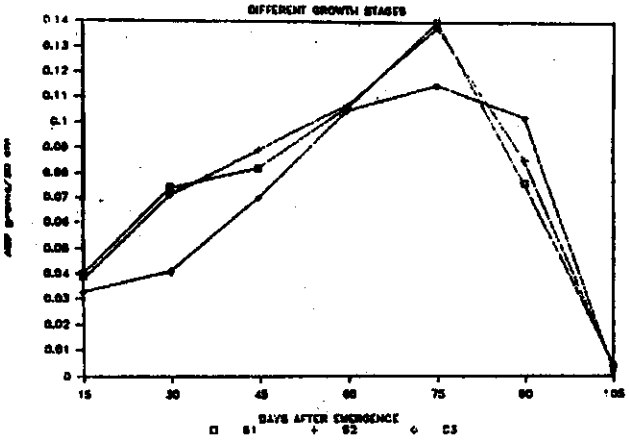

Fig. 1(d): AGR of Root as Affected by Different Growth Stages

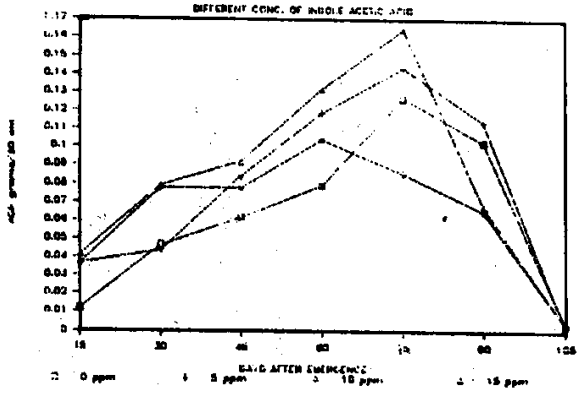

Fig. 1(b): AGR of Root as Affected by Different conc of Indole Acetic Acid

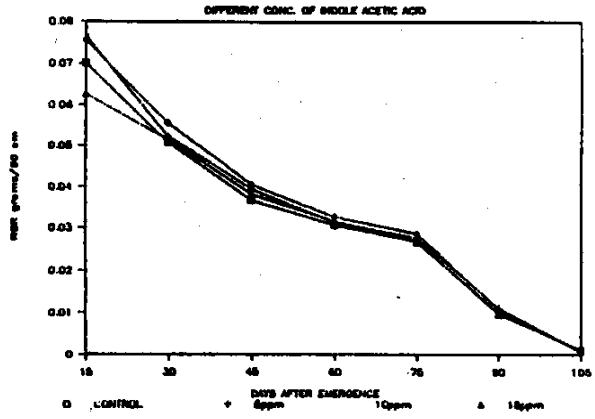

Fig. 2(a): AGR of Shoot as Affected by Different Conc. of indole Acetic acid

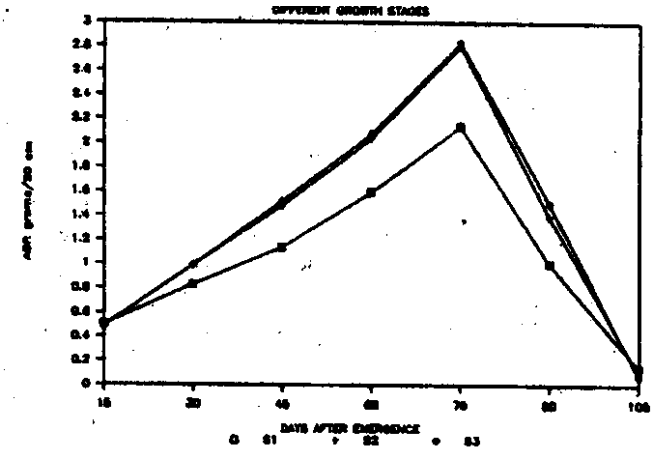

Fig. 1(c): AGR of Shoot as Affected by Different Growth Stages

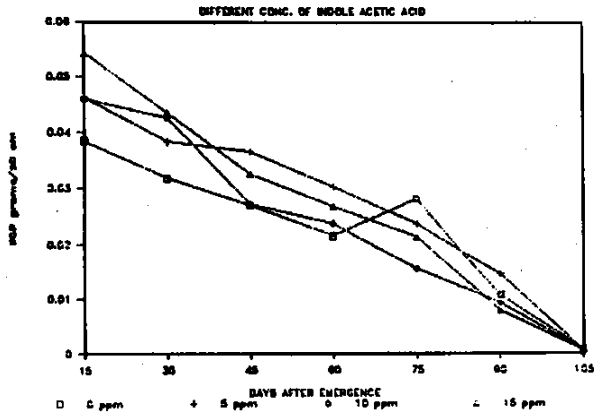

Fig. 2(b): RGR of Root as Affected by Different Conc on Indole of Acetic Acid

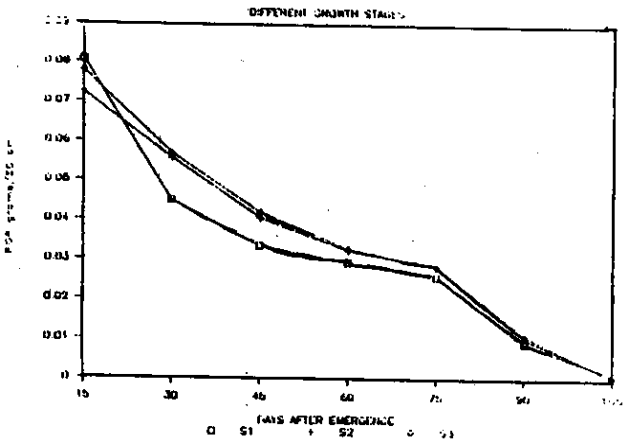

Fig. 2(c): RGR of Shoot as Affected by Different Growth Stages

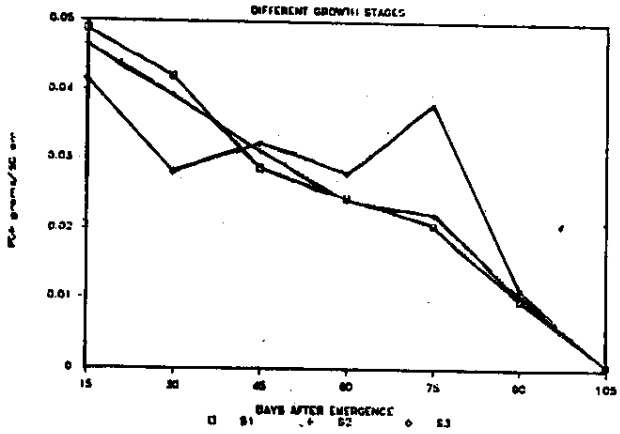

Fig. 2(d): RGR of Root as Affected by Different Growth stages

has no effect on growth and development. If concentration is high, this may cause obstacle to penetrate in to the plant body, in assimilation and translocation from one part to another, which may impair the process, whereas 10 ppm was highly effective because of normal concentration but the lower concentration will not permit to the desired results. The shoot linearly affected at different stages, revealed that the most important factor was the concentration rather than stages especially in vegetative stage. IAA at 5 ppm affected significantly the AGR of root but on average it is evident that each concentration has some effect on root. AGR of root as affected by stages showed that IAA applied at any stage may fully give benefit to the root but the shoot unlike the root, after maturity may be unable to absorb the growth regulator which is physiological habit of root (Baz *et al*., 1989). Haissag (1979) observed that IAA and IBA greatly enhanced adventitious root primordium initiation in phaseolous bean. Gamburg and Osharova (1982) reported that the methyl-substituted phenoxy acetic acid increased the growth of soybean cell culture.

Relative growth rate (RGR): The RGR of shoot (Fig. 2a) indicated that RGR was maximum at 10 ppm concentration up to 75 days after emergence but after that period no difference was observed at various concentrations. RGR of root as affected by various concentrations (Fig. 2b) showed that RGR was maximum at 15 ppm during the early 30 days after emergence but rather than period, RGR was tremendous at 5 ppm concentration. RGR of shoot as affected by different growth stages (Fig. 2c, d) displayed that RGR at seed filling stage was maximum up to 60 days but then flowering and seed filling stages had similar effect on RGR. RGR of root revealed that it was maximum at 15 days after emergence stage up till 30 days after emergence but after that RGR at seed filling stage was increased and remained constant till maturity. RGR of shoot has a positive response to concentration of 10 ppm, at vegetative stage, revealing that relative mass gaining usually takes place during vegetative phase. In contradiction to RGR of shoot, RGR of root has a stimulus toward the 15 ppm showing that as compared to shoot, root were awaiting for higher concentration because of rigid physiological nature and translocatory pattern where as the roots were ready to get IAA during the juvenile stage. The roots responded similarly to the concentrations as well as stages. RGR was maximum at early stages because of the fact that the root development takes place in early life of plant and after early stages, the root growth generally ceased off as to support the shoot part (nutrients + support) and hence IAA remained ineffective after root growth has been stopped. Kandasamy and Prasad (1975) observed that application of 50 ppm GA3 or 250 ppm IAA on *C. juncea* increased rhizosphere IAA content but decreased Rhizobium population. Lee and Chung (1982) reported that soybean sprouts treated with IAA had considerably shorter root than control. Weight and diameter of treated sprouts were increased by 10-20 percent and 40 percent respectively compared with control.

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