



## Synergistic and inhibitory effects of Plant Growth regulators on Soybean (*Glycine max* L. Merrill)

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Received date: March 12<sup>th</sup> 2013; Accepted date: March 28<sup>th</sup> 2013; Published date: July 1<sup>st</sup> 2013

### Abstract:

As the title indicates the current work aims to identify the inhibitory effect of plant growth regulators on the growth conditions of soybean. The work revealed that, seed yield and yield components were significantly increased by NAA at 20 ppm over other treatments and control. The application of brassinosteroid at 25 ppm, mepiquat chloride 5% AS and chlormequat chloride applied at 187.5g a.i/ha, 162.5g a.i/ha and 137.5g a.i/ha had also resulted in higher seed yield, compared to control and water spray. The study revealed the superiority of NAA (20 ppm) treatment for majority of the morphological, physiological, growth, biochemical, quality and yield parameters at different growth stages, in addition to seed yield, compared to other growth regulator and control treatments. Suggesting the use of NAA will have many positive benefits on yield and yield attributing characters in *rabi*-soybean.

**Keywords:** Soybean, Growth Regulators, Glycine Max L.Merrill, NAA, Chlormequat chloride, Mepiquat Chloride, Cycocel, Brassinosteroid

### Introduction:

Soybean (*Glycine max* L. Merrill) has been called miracle crop of the twentieth century. It is a highly nutritive and energy rich legume with 43 percent of biologically effective protein and 20 per cent of edible oil, besides the presence of good amount of vitamins, minerals, salts and essential amino acids. It serves both as pulse and oil seed crop and gives 2-3 times more protein yield than other pulses<sup>(1)</sup> and can bridge the increasing gap between demand and supply for edible oils and pulses in the country. Being a legume, it also fixes atmospheric nitrogen and adds about 65-100 kg N ha<sup>-1</sup> year<sup>-1</sup> to the soil which helps in increase of yields of the subsequent non-legume crop<sup>(2)</sup>. The general constraint for

realization of high productivity levels in soybean, its cultivation in marginal lands with either limited soil moisture or rain fed conditions. Further, the indeterminate growth habit, lack of high yielding varieties, apart from specific inherent physiological constraints, like less partitioning of assimilates towards reproductive structures, abscission of flowers or buds, also contribute to low pod set resulting in low yields of the crop. Growth regulators are known to improve the source-sink relationship, translocation of photo-assimilates and thereby photosynthetic ability of the plants and thus play a significant role in realization of high productivity levels and higher crop yields. The use of plant growth regulators has therefore been described as the most important tool of the agriculturist to increase crop yields<sup>(3)</sup>. Among the growth regulators, auxins promote growth along the longitudinal axis, when applied in low concentration to shoot of the plant, while growth retardants are known to reduce the inter nodal length<sup>(4)</sup>, reduce plant height, influence source-sink relationship and stimulate the translocation of photosynthates towards sink. Foliar application of mepiquat chloride<sup>(5)</sup> was also reported to help in realization of higher assimilatory rates resulting in higher dry matter production. Cycocel, another growth retardant was reported to shorten and strengthen stems of the plants and thereby reduce losses caused by lodging. The application of brassinosteroids was also reported to induce plant growth due to an increase in the metabolic processes like photosynthesis<sup>(6)</sup> and protein synthesis. Though, the plant growth regulators have great potential, their application and accurate assessment, etc., have to be judiciously planned in terms of optimal concentrations, stage of application, species specificity and the correct season. In view of their wide spectrum of effectiveness on every aspect of

plant growth, even a modest increase of 10-15 per cent could bring about an increment in the gross annual productivity by 10-15 million tones <sup>(7)</sup>. The comparative study of growth promoting and retarding compounds in pulses, particularly, soybean is scanty. Hence, the present investigation was undertaken to study the efficacy of chlormequat chloride, mepiquat chloride, NAA and brassinosteriod on the growth, development and yield of the crop.

**Material and Methods:**

The present investigation entitled “The synergistic and inhibitory effects of certain plant growth regulators on Soybean (*Glycine max* L. Merrill)” was undertaken during *rabi* 2008-09 season at the College Farm, College of Agriculture, Rajendranagar, Hyderabad, situated at an altitude of 542.6 m and geographical bearing of 18°50’N latitude and 77°53’E longitude. The material and methods followed in the experiment are furnished hereunder.

The field trial was conducted following randomized block design with nine treatments replicated thrice. Each plot measured 3.9 x3.9 m. A spacing of 30 x 10 cm was maintained between and within the rows. The field was laid out into bunds of 75 cm spacing with cattle drawn bund former. Between the replications, one meter space was left for irrigation.

The present investigation consists of soybean *cv* JS-335 and two growth promoting (NAA and Brassinosteroid) and two growth retarding substances (chlormequat chloride and mepiquat chloride). These growth regulators were sprayed at flower initiation stage. The experiment was conducted with these four chemicals involving nine treatments .The details of the treatments are furnished below. All the plants from one meter square were harvested at maturity to record data on the following yield attributes, namely, number of seeds per pod, number of pods per plant and 100-seed weight. After threshing, cleaning and drying, seed yield from one m<sup>2</sup> area from each treatment and replication was recorded and the data was used to express the seed yield on hectare basis.

**Results and Discussion:**

Yield is the manifestation of physiological processes occurring in plants over time and is related to the production of dry matter and its proper partitioning. In general, crop yield depends not only on the accumulation of photo assimilates during the crop growth and development, but also on its partitioning in the desired storage organs of plant. The growth regulators are capable of redistribution of dry matter in the plant and there by bringing about an improvement in the yield potential <sup>(8)</sup>.

**Table 1: Effect of plant growth regulators on yield and yield attributes in *Rabi* -soybean**

	<b>Treatments</b>	<b>No. of seeds/pod</b>	<b>No. of pods/Plant</b>	<b>100 seed weight (g)</b>	<b>Seed yield (kg.ha<sup>-1</sup>)</b>
<b>T<sub>1</sub></b>	<b>Chlormequat chloride 50 % SL (137.5g a.i/ha)</b>	<b>2.73</b>	<b>29.66</b>	<b>13.75</b>	<b>1472.33</b>
<b>T<sub>2</sub></b>	<b>Chlormequat chloride 50 % SL (162.5g a.i/ha)</b>	<b>2.78</b>	<b>30.33</b>	<b>13.76</b>	<b>1491.00</b>
<b>T<sub>3</sub></b>	<b>Chlormequat chloride 50 % SL (187.5g a.i/ha)</b>	<b>2.89</b>	<b>31.86</b>	<b>14.08</b>	<b>1502.66</b>
<b>T<sub>4</sub></b>	<b>Chlormequat chloride 50 % SL (375g a.i/ha)</b>	<b>2.25</b>	<b>25.42</b>	<b>13.51</b>	<b>1449.66</b>

<b>T<sub>5</sub></b>	<b>Alpha naphthyl acetic acid (NAA) 20 ppm</b>	<b>3.05</b>	<b>34.66</b>	<b>14.27</b>	<b>1563.33</b>
<b>T<sub>6</sub></b>	<b>Mepiquat chloride 5 % AS (5 %)</b>	<b>2.80</b>	<b>31.00</b>	<b>13.86</b>	<b>1504.66</b>
<b>T<sub>7</sub></b>	<b>Brassinosteroid (25 ppm)</b>	<b>2.94</b>	<b>32.33</b>	<b>14.26</b>	<b>1548.66</b>
<b>T<sub>8</sub></b>	<b>Water</b>	<b>2.19</b>	<b>26.29</b>	<b>13.45</b>	<b>1437.66</b>
<b>T<sub>9</sub></b>	<b>Control</b>	<b>2.06</b>	<b>25.66</b>	<b>13.85</b>	<b>1411.33</b>
	<b>Mean</b>	<b>2.63</b>	<b>29.69</b>	<b>13.87</b>	<b>1486.81</b>
	<b>Sed</b>	<b>0.07</b>	<b>0.63</b>	<b>2.47</b>	<b>6.09</b>
	<b>C.D (0.05)</b>	<b>0.15</b>	<b>1.34</b>	<b>NS</b>	<b>12.98</b>

In the present study (results are presented in Table. 1), a perusal of these results revealed the existence of significant differences among the treatments studied in the present investigation. Among the treatments, application of NAA (20 ppm) had recorded significantly higher seed yield (1563.33 kg ha<sup>-1</sup>), compared to other treatments studied. The treatments, brassinosteroid applied at 25 ppm (1548.66 kg ha<sup>-1</sup>) and mepiquat chloride (5%AS) applied at 5% (1504.66 kg ha<sup>-1</sup>) had also recorded significantly higher seed yield, compared to control (1411.33 kg ha<sup>-1</sup>) and water spray (1437.66 kg ha<sup>-1</sup>)<sup>(9)</sup>.

Further, the application of chloromequat chloride 50% SL at different concentrations had also resulted in significantly higher seed yield, compared to control and water spray, except for chloromequat chloride 50% SL applied at high concentrations of 375g a.i/ha (1449.66 kg ha<sup>-1</sup>), which was noticed to be on par with water spray (1437.66 kg ha<sup>-1</sup>) treatment.

The yield components, viz., number of seeds per pod and number of pods per plant; and seed yield were strongly influenced by the application of different growth regulators, indicating the importance of these compounds in increasing the yield potential through their effect on various morphological, physiological, biochemical and yield component traits<sup>(10)</sup>. The

application of different growth regulators was observed to result in significant increased in the number of seeds per pod, number of pods per plant, and hence, the seed yield. The application of NAA (20 ppm) had resulted in significantly higher seed yield (1563.33 kg ha<sup>-1</sup>) followed by brassinosteroid applied at 25 ppm (1548.66 kg ha<sup>-1</sup>), mepiquat chloride 5%AS (1504.66 kg ha<sup>-1</sup>) and chlormequat chloride applied at 187.5g a.i/ha (1502.66 kg ha<sup>-1</sup>), 162.5g a.i/ha (1491.00 kg/ha<sup>-1</sup>) and 137.5g a.i/ha (1472.33 kg ha<sup>-1</sup>), compared to control (1411.33 kg ha<sup>-1</sup>) and water spray (1437.66 kg ha<sup>-1</sup>). The increased yield may be attributed to higher dry matter production, CGR and chlorophyll content. All these parameters are having a significant and positive correlation with seed yield. Several research workers had also reported similar increase in yield components and yield with the application of NAA<sup>(11)</sup>, brassinosteroid<sup>(12)</sup> and chlormequat chloride<sup>(13)</sup> that the foliar application of mepiquat chloride significantly increased the yield in groundnut and soybean crops, respectively.

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