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Role of Gibberellic Acid, Leaf Extract of Azadirachtaindica and Pongamiapinnata on Growth and Productivity of Garlic

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ABSTRACT

A pot experiment was carried out to evaluate the effects of foliar application of four different concentrations of GA3 and leaf extract of Azadirachtaindica and Pongamiapinnata on garlic plants. An experiment was carried out with three replications. The growth characteristics e.g. root length, shoot length; number of leaves, fresh weight and dry weight, growth and vigour index etc. were studied. The biochemical contents like chlorophyll a, b and total chlorophylls as well as relative water content contents were studied. The four different concentrations of GA3 were made in absolute alcohol and the dilutions were made in distilled water. For the foliar spray 25 ppm, 50ppm, 75ppm and 100 ppm concentrations of GA3 was used at an interval of 7 days each. The leaf extract of Azadirachtaindica and Pongamiapinnatawas made by crushing 10 g leaves in 100 ml of distilled water and stored in refrigerator separately. The six sets of garlic plants were made with six plants in each set. Among each set of six plants three plants were used as control and three as replicates. The leaves of all the three replicates were sprayed with 25, 50, 75 and 100 ppm of GA3, leaf extract of Azadirachtaindica and Pongamiapinnatarespectively. The first treatment was given after completing the growth for 40 days and the subsequent sprays were given after every seven days. All the plants were watered after every six days. The foliar spray was applied for five times and the plants were used to study the growth parameters after 120 days. Leaf extracts showed comparatively better results than GA3.

Keywords : Gibberellic Acid, Garlic, Azadirachta, Pongamia, Yield

I. INTRODUCTION

Garlic (*Allium sativum* L.) belongs to family Liliaceae and it is an important bulb vegetable due to its medicinal and nutritional values[1]. Garlic is a bulbous plant closely related to the onion. Garlic is produced commercially for its composite bulb, which consists of several individual bulblets, known as 'cloves.' These individual bulblets are enclosed in a membranous bag that is whitish or purplish in color. In its fresh form, garlic is usually sold as a composite bulb. Garlic is noted for its pungent odor, which is caused by organic sulphur compounds. These compounds reportedly possess antibacterial properties, which have played a role in folk medicine from time immemorial. The major use of garlic is as a flavoring in cooking. In addition to use in its fresh form, garlic is also processed into numerous dehydrated products and may be pureed or frozen. A portion of each year's production is also used as seed garlic for planting future crops.

Plant growth regulators like Gibberellic acid to boost crop growth and yield [2]. It also has stimulating effects on most morphological, physiological and biochemical aspects of plant growth have additive impacts on overall growth and development of plants[3]. Application of GA_3 at full bloom increases plant growth and vigour including fruit size [4].

The leaves of the plants of *Azadirachtaindica* A. Juss. and *Pongamiapinnata* L. are traditionally being used as medicines, antiseptic, pesticides, insecticides and biofertilizers. The leaves contain minerals and nutrients [5]. The leaves of neem plant contain azadirachtin, meliacin, gedunin, salanin, nimbin, valassin etc. The leaf extract is best environmental friendly and a pesticide as well as the source of phosphate fertilizers [6].

At present research work the prominence has given to evaluate the utility of different concentrations of GA_3 and leaf extract of *Azadirachtaindica* A. Juss., and *Pongamiapinnata* L. on growth, vigour, biochemical

content and yield of *A. sativum* (Garlic) plants in pot experiment.

II. METHODSANDMATERIAL

The garlic cloves were planted in plastic bags of 30 cm diameter. The bags were filled with the soil and sand with the ratio of 3:1. Each bag was filled with 4 kg of soil and sand mixture. Total six sets with control plants were prepared with three replicates each. The bags were placed in Botanical garden under natural conditions. From each set of six bags three bags were treated with foliar spray (experimental) and three were maintained as control. The cloves were grown as seedlings after 8-10 days. The seedlings kept in the bags for the growth. After six weeks i.e. 42 days of normal growth the first foliar spray was initiated in all the experimental plants. The experimental plants of all the four sets of GA_3 were sprayed with 25, 50, 75 and 100 ppm of GA_3 respectively and fifth and sixth set was sprayed with the leaf extract of *Azadirachtaindica* and *Pongamiapinnata* respectively. The leaves were sprayed after every seven days for four weeks and watered after every six days. The foliar spray was given for five times and after 120 days the garlic plants were analyzed for study of growth parameters and biochemical contents.

Stock solution of Gibberellic acid was made in absolute alcohol and the different dilutions were made in distilled water and stored at refrigerator for further use. The fresh leaves of *Azadirachtaindica* and *Pongamiapinnata* were collected and washed thoroughly after drying the leaves with blotting paper; the leaves were weighed 10 g and grinded in 100 ml of distilled water. The grinding was carried out by using blender and the leaf extract was stored separately in refrigerator for further use.

Leaf length and root length was measured by using measurement tape and germination percentage were calculated by counting the number of seeds grown and number of seedlings germinated the growth and vigour index (GVI) of all the plants was calculated by using formula. As there is no true shoot in onion we have considered here leaf length as shoot length. By using the formula of[7], [8], [9]. GVI = shoot length x Root length x germination percentage.

Number of leaves was directly counted and recorded. Fresh weight of garlic cloves were recorded by using electric balance. Dry weight of garlic cloves (bulblets) were recorded after placing them in incubator at 50°C for 96 hours.

The amount of chlorophyll a; chlorophyll b and total chlorophylls was determined by Arnon's method, [10]. Chlorophyll extract was prepared from fresh leaves (100 mg) of garlic by grinding in a pre chilled mortar and pestle, together with 10 ml of ice cold 80% acetone. The homogenate was centrifuged at 3000 rpm for 2 minutes in cooling centrifuge. The supernatant was saved and pellet was re-extracted twice with 5 ml of 80% acetone. All the supernatants were pooled and saved.

The absorbance of the extract was recorded at 663 nm, 645 nm and the concentration of chlorophyll a, chlorophyll b and total chlorophyll was calculated using Arnon's equations as follows.

Chl. a = (12.7 × A663-2.69 × A645) × 10 /mg leaf weight
Chl. b = (22.9 × A645-4.61 × A663) × 10 /mg leaf weight
Total Chl. = (20.2 × A 645-8.02 × A 663) × 100 /mg leaf weight

The relative water contents were studied by Barr and Weatherley, method[11]. For this the leaves were sliced in to 5-10 cm^2 pieces and then weighed immediately to record fresh weight. Leaf sample was floated in deionized water in Petri dish for 4 hours at normal room temperature and light. After 4 hours, the sample was taken out from water, and surface water was removed and again weighed to obtain fully turgid weight. Sample was dried in an oven at 80°C for 24 hours weighed again. It is calculated using following formula.

$$\text{RWC (\%)} = \frac{(\text{Fresh wt.} - \text{dry wt.})}{(\text{turgid wt.} - \text{dry wt.})} \times 100$$

III. RESULTS AND DISCUSSION

After the growth of 120 days the growth parameters like number of leaves, length of leaves and length of roots of the garlic plants was recorded. The number of leaves was recorded more in the garlic plants which were sprayed with Gibberellic acid and leaf extracts than the

control plants in all the sets. The minimum number of leaves recorded was ranging in between 8 and 9 in control plants. The maximum number of leaves (11) was recorded in plants sprayed with leaf extract of *Pongamiapinnata.* It was recorded 11 and 10 in plants sprayed with 100 ppm GA3 and leaf extract of *Azadirachtaindica*respectively. Other treated plants showed 5 to 9 leaves. The application of the foliar nutrition and GA_3 on garlic leaves increased their metabolism and this has resulted in increased number of leaves in all the replicates as compared to control plants (Table 1).

The root as well as leaf length was recorded more in all the experimental plants as compared to control plants. The increased concentrations of GA_3 had positive response on the root and leaf length. At 25 ppm concentration of GA_3 the root and leaf length was minimum whereas the plants sprayed with the extract of *Pongamiapinnata* showed maximum.

At all the concentrations of GA_3 the root and leaf length was recorded more than control plants. Germination percentage of all the sets was cent percent. The growth and vigour index of all replicates was recorded more than the control plants. Our results corroborate with the results recorded by Mislevy*et al.,*[12],Harrington *et al.,* [13]Tanimoto[14], Maske*et al.,*[15],Awan and Alizai[16],Lee [17], Sarkar *et al.,*[18].

Table 1. Effect of different concentrations of GA3 and leaf extracts *Azadirachtaindica* and *Pongamiapinnata*on number of leaves, leaf length and root length of onion plant after 110 days.

Garlic	Root length (cm)	No. of leaves	leaf length (cm)	GVI
Control	2.00	6	23.00	4600
GA 25 ppm	2.50	9	26.50	6625
Control	2.25	5	22.75	5119
GA 50 ppm	2.75	9	27.25	7494
Control	2.00	5	23.75	4750
GA 75 ppm	2.75	9	27.50	7563
Control	2.00	6	23.00	4600
GA 100 ppm	2.75	11	28.00	7700
Control	2.00	6	24.75	4950
Pongamiapinnata	3.25	11	27.50	8938
Control	2.25	6	23.25	5231
Azadirachtaindica	3.00	10	27.75	8325

The foliar spray of leaf extract of *Pongamiapinnata*and *Azadirachtaindica*also showed positive response on root and leaf length. The root and leaf length of treated garlic plants was more than control plants. The growth response of garlic plants sprayed with extract of *Pongamiapinnata* was more as compared to *Azadirachtaindica.* The effect of leaf extract of *Pongamiapinnata*was same as in plants treated with GA3.

Gibberellic acid has stimulating effect on all the physiological and biochemical aspects of plant growth and has additive impacts on overall growth and development of plants. It is a most important growth hormone which regulates plant growth Mikitzel, [19],(EL-Naggar*et al.,*[20].

The growth and vigour index of all the foliar sprayed plants was more than control plants (Table 1). The highest GVI was recorded in foliar sprayed plants of *Pongamiapinnata* and*Azadirachtaindica.* This enhancement in the GVI was resulted due to increased cell division and cell elongation. Similar results were obtained by Kothule*et al.,*[21],Yadav and Abha-Tikkoo[22],Behairy and Rizk[23],El-Sayed et *al.,*[24], Alexopoulos*et al.,*[25]. The leaf extract of *Pongamiapinnata* and *Azadirachtaindica* has high nutrient contents and if sprayed on leaves they give jump start to the growth of plants.

The chlorophyll content of garlic leaves were analyzed after 75 days from fresh leaves by Arnon's, (1949) method. The amount of chlorophyll a was recorded minimum in control plants of all the sets (Figure 1). It was recorded highest in plants sprayed with 100 ppm of GA3 and the plants sprayed with leaf extract of *Pongamiapinnata*. The plants sprayed with leaf extract of*Azadirachtaindica* also recorded higher amount of chlorophyll a. The results were similar for the chlorophyll b and total chlorophylls. The increased amount of the chlorophyll a, b and total chlorophylls might have resulted due to the GA3 in first four sets and nutrient contents of leaves of *Pongamiapinnata* and *Azadirachtaindica*in last two sets.

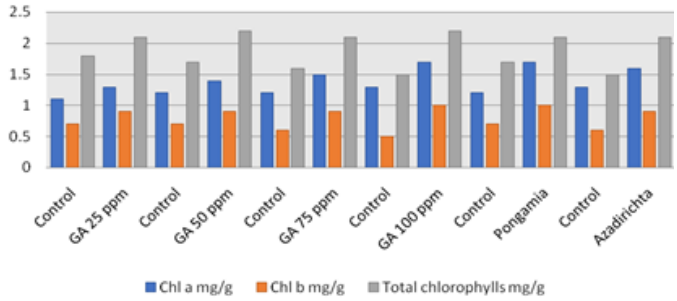

Figure 1. Effect of different concentrations of GA3 and leaf extracts of *Azadirachtaindica* and *Pongamiapinnata*on chlorophyll content of garlic leaves after 75 days.

Application of GA3 increases absorption potential and assimilation of mineral nutrients during vegetative growth stage (Shah andSamiullah, 2006). It is possible that GA3 had the potential to accelerate the nutrients partitioning towards cells and active growth sites and concomitantly increases those nutrients absorption via increased root potential, and finally intensifies minerals and their related bio-molecules accumulation in shoots especially new leaves and apical shoots passing active growth and development. GA3 links with chlorophyll biosynthesis in leaves and hence showed positive effects on plants chlorophyll content. Our results are in agreement with the results of Shah andSamiullah[26], Reda *et al.,*[27].

The relative water content (RWC) in garlic leaves were recorded after growth of 75 days. The RWC from leaves was recorded more in all plants which were applied foliar sprays than control plants (Figure 2). The increased cell division, cell size and cell number was due to GA3 and availability of nutrients in the leaves of *Azadirachtaindica* and *Pongamiapinnata* increased the metabolism of the plant. Increased contents of chlorophylls in the leaves enhanced the photosynthetic efficiency of the plants which resulted in increased growth and vigour. Foliar nutrients were absorbed by the leaves of onion plants and utilized well and hence the RWC in all the plants which were applied foliar sprays was more than control plants. Garcia and Hanway, [28];Brantly, [29] obtained the similar results.

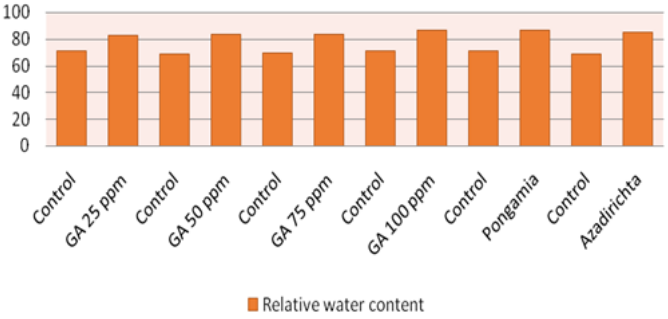

Figure 2. Effect of different concentrations of GA3 and leaf extract of *Azadirachtaindica* and *Pongamiapinnata*on relative water content (RWC) of garlic leaves after 75 days.

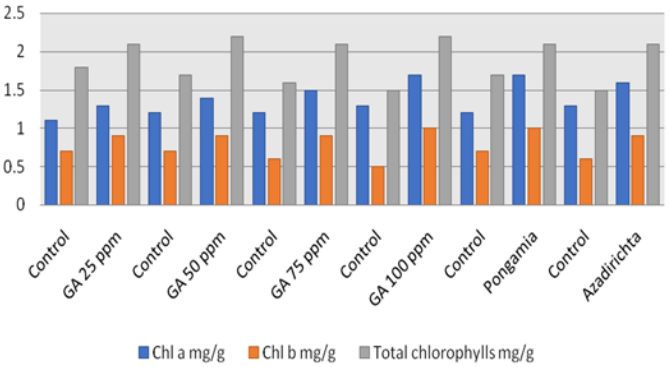

Figure 3. Effect of different concentrations of GA3 and leaf extract of *Azadirachtaindica* and *Pongamiapinnata*on fresh weight and dry weight of non tunicated bulb of garlic.

The fresh weight as well as dry weight of garlic bulblets after 110 days was more in all the experimental plants than control plants of onion (Figure 3). The GA3 speeds up the nutrients partitioning towards cells and active growth sites and along with increases nutrient absorption and finally reinforce minerals absorption and their related bio-molecules accretion in leaves and apical shoots passing active growth and development. The root length, leaf length and growth vigour index was enhanced in all the experimental plants. The increased leaf length leads to increased surface area of leaves and this resulted in more absorption of nutrients and higher photosynthetic efficiency. Due to this the root length of the plants was recorded more in all the experimental plants. Root and leaf length collectively had improved response of plants with respect to chlorophyll content, photosynthetic efficiency, relative water content etc. Hence the fresh weight of the plants was more in all the experimental plants as compared to the control plants.

Our results are in line with the findings of Amal *et al.,*[30], Bideshki*et al.,*[31].

IV. CONCLUSIONS

The present research work showed the role of GA3 and leaf extracts of *Pongamiapinnata*and *Azadirachtaindica* in the growth of the garlic plants was positive. The optimum concentration of GA3 for the growth of onion was 100 ppm. The foliar nutrition of the *Pongamiapinnata* (10 g / 100 ml) influenced the growth of garlic plants similar to 100 ppm GA3. The results of the foliar spray of leaf extract of *Azadirachtaindica* were also superior to the results of 75 ppm GA3. Among the results of leaf extract foliar sprays of *Pongamiapinnata*showed better results than leaf extract of *Azadirachtaindica.*

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