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# Response of gibberellic acid and cycocel on growth, yield and quality of cowpea [*Vigna unguiculata* (L.) Walp.] CV. AVCP-1

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**Abstract**
The investigation entitled “Response of gibberellic acid and cycocel on growth, yield and quality of cowpea [*Vigna unguiculata* (L.) Walp.] cv. AVCP-1” was conducted during summer 2017 at Fruit Research Station, Lal Baug, Department of Horticulture, College of Agriculture, J. A. U., Junagadh. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications consist of two factor with sixteen treatments. Treatments consist of different level of $GA_3$ (0,150,250 and 350) and CCC (0,200,300 and 400). Observations were recorded on the basis of five random competitive plants selected from each plot separately for morphological, growth analytical, phenological, and yield parameters were evaluated as per standard procedure and also estimate the economics. The results found that foliar application of $GA_3$ has significantly increase growth as well as yield attributes. However, growth retardant like cycocel reduced plant height and hence causing dwarfness to the plant. Among the different treatment, the foliar application of $GA_3$ at concentration of 150 and 250 ppm, whereas CCC at concentration of 200 ppm, was found to be better alternatives for boosting, up the production of Cowpea cv. AVCP-1.

**Keywords:** Cowpea, AVCP-1, $GA_3$, CCC

## Introduction

Cowpea [*Vigna unguiculata* (L.) Walp.], 2n=2x=22 belongs to family Fabaceae, popularly known as *chili* is an important legume vegetable crop. Cowpea, whether utilized for green pods as vegetable or dry seed as pulse, form an important component of farming systems from the arid to the humid tropics. In fact, it probably has the greatest potential among all food legumes in the semi-arid to sub-tropical areas. Cowpea cultivars grown for the immature green pods as vegetable are variously known as asparagus bean, snake bean and yard long bean and when grown for dry seeds, they are known as black-eye pea, kaffir pea, china pea and southern pea.

It is the key dietary staple for the poorest sector of many under developed and developing countries of Africa, Latin America and Asia. It is the crop of all round utilization grown for tender pods and seeds, dry seeds as pulses, green leaves and even roots. It is equally liked by both poor and rich and is quite high in nutritive value. It is tolerant to drought and most of the soil stress, thus can be grown over a wide range of environmental conditions. Effective cowpea- *Rhizobium* symbiosis can fix about 150 kg atmospheric nitrogen per hectare. It is also grown for hay, silage, pasture for all types of live stock. It is also used as fodder and green manure crop. (Chattopadhyay *et al.* 2007) [10]. It is widely grown in Africa, Latin America, Southern Asia and in the Southern United States. Long, thick poded and trailing type varieties are grown in Kerala, Tamil Nadu, Andhra Pradesh and West Bengal. In Haryana, Uttar Pradesh, Bihar and Madhya Pradesh, it is grown for dry seeds whereas Punjab, Gujarat and Madhya Pradesh prefer short and thin pods of cowpea.

In India cowpea is cultivated as one of the leading legume vegetable crop, covering an area of 1.5 million ha, with an annual production of 0.7 million tonne and having productivity of 4.6 t/ha. Gujarat state occupies an area of 26883 ha, with an annual production of 2.85 MT and having productivity of 10.61 t/ha (Saravaiya *et al.* 2014) [33].

Plant growth regulators or plant regulators are the synthetic oraganic compounds other than nutrients which modify or regulate or inhibit or promote, plant physiological processes in an appreciable measure when used in small concentrations. They are readily absorbed and these chemicals move rapidly through the tissues when applied to different parts of plant. Many of these chemical compounds have been manufactured and tested and it is seen that the behavior and response of each crop is highly variable according to the composition and concentration of the compounds. These synthetic PGRs are put into several uses in horticulture, one of them is to increase crop yield and improve quality.

Gibberellic acid ($GA_3$) is known to improve physiological efficiency including photosynthetic ability of plants and offer a significant role in realizing higher crop yields. Foliar application of $GA_3$ enhances plant growth and development by encouraging cell elongation and division resulting in larger produce, extended shelf life, increased plant vigour and better pod set. Mukhtar and Singh (2006) [22] reported that $GA_3$ stimulated an increase in growth, flowering, pod maturity and grain yield of cowpea. Therefore, application of plant growth regulators such as gibberellins may promote elongation of internodes and hence increase yield. Richards *et al.* (2001) [32] reported that exogenous application of gibberellic acid induced flowering and affected flower morphology. Spraying of PGRs just before flowering increase the yield of pod (Selvakumar 2014).

Cycocel (CCC) is a potent synthetic growth retardant. Cycocel retards stem elongation by preventing cell division in sub-apical meristem, usually without similarly effecting the apical meristem. Cycocel influences very significantly the vegetative growth of plants, without effecting the flower bud initiation, number of leaves, number of flowers, duration of flowering, and emergence of flower and increases the number of branches. The crop improvement in the vegetable crops especially in cowpea is a primary problem as it is a highly self pollinated crop. So, there is a need to increase cowpea productivity with limited land and available resources.

Now a day several horticultural practices are there for obtaining higher yield and quality of vegetable crops. But most of farmers do not adopt them due to unawareness of these practices. Production of vegetable crops in summer season under open condition is limited due to high temperature and water scarcity. Cowpea is a hardy crop easily cultivated in summer season but does not produce maximum yield. Application of PGR in vegetable crops is easy with successful results in terms of higher yield and quality of vegetable crops.

## Materials and Methods

A present experiment was laid out during the year of 2017 at Fruit Research Station, Lal Baug, Department of Horticulture, Junagadh Agricultural University, Junagadh. The experimental material for the present investigation was comprised of sixteen treatments (Table 1).

These treatments are laid in Factorial Randomized Block Design with three replications. Observations were recorded on the basis of five random competitive plants selected from each plot separately for morphological, growth analytical, phenological and yield parameters were evaluated as per standard procedure and also estimate the economics.

**Table 1:** Treatment details

| Sr. No. | Treatment | Treatment combination |
|---|---|---|
| $T_1$ | $G_0C_0$ | Water spray |
| $T_2$ | $G_0C_1$ | Cycocel 200 ppm |
| $T_3$ | $G_0C_2$ | Cycocel 300 ppm |
| $T_4$ | $G_0C_3$ | Cycocel 400 ppm |
| $T_5$ | $G_1C_0$ | $GA_3$ 150 ppm |
| $T_6$ | $G_1C_1$ | $GA_3$ 150 ppm + Cycocel 200 ppm |
| $T_7$ | $G_1C_2$ | $GA_3$ 150 ppm + Cycocel 300 ppm |
| $T_8$ | $G_1C_3$ | $GA_3$ 150 ppm + Cycocel 400 ppm |
| $T_9$ | $G_2C_0$ | $GA_3$ 200 ppm |
| $T_{10}$ | $G_2C_1$ | $GA_3$ 200 ppm + Cycocel 200 ppm |
| $T_{11}$ | $G_2C_2$ | $GA_3$ 200 ppm + Cycocel 300 ppm |
| $T_{12}$ | $G_2C_3$ | $GA_3$ 200 ppm + Cycocel 400 ppm |
| $T_{13}$ | $G_3C_0$ | $GA_3$ 250 ppm |
| $T_{14}$ | $G_3C_1$ | $GA_3$ 250 ppm + Cycocel 200 ppm |
| $T_{15}$ | $G_3C_2$ | $GA_3$ 250 ppm + Cycocel 300 ppm |
| $T_{16}$ | $G_3C_3$ | $GA_3$ 250 ppm + Cycocel 400 ppm |

## Results and Discussion

### 1. Response of foliar application $GA_3$

### 1.1 Growth Characters

Various concentration of foliar application of $GA_3$ showed significant variation in days to 50 % flowering, plant height at final picking, days to first picking and days to last picking. The minimum days to 50 % flowering (44.58 days) was recorded under the treatment $G_0$ (water spray), while it was statistically at par with $G_1$ (150 ppm). The increase in number of days taken to 50% flowering by $GA_3$ application might be due to diversion of food material for vegetative growth which leads to the delaying of flowering and fruiting. Similar results were reported by Arya *et al.* (1999) [5] and Rathod *et al.* (2015) [30] in french bean.

The foliar application of $G_3$ (250 ppm) produce taller plants (60.68 cm) which was followed by $G_2$ (200 ppm) and $G_1$ (150 ppm). Gibberellins promote stem elongation which might be due to the hormonal action of enhancing cell division and cell elongation in growing portion of plants and increased uptake of nutrients by increased photo synthetic activity, enhancement in the mobilization of photosynthates and change in the membrane permeability (Pandita *et al.*, 1980) [27]. At higher concentration of $GA_3$ the increased plant height might be due to quick cell multiplication and cell elongation (Sharma and Lashkari, 2009) [35]. These results are in conformity with the results reported by Pandey *et al*. (2004) [26] in garden pea and Nawalagatti *et al*. (2009) [23] in french bean, Ogbona and Abraham (1989) [25] and Mishriky *et al.*

(1990) [20] in pea, Emongor (2007) [11] in cowpea and Fawzy *et al.* (2011) [12] in snap bean.

Significantly minimum values for days to first picking (49.34 days) was observed with $G_1$ 150 ppm which was followed by treatments $G_0$ (water spray) and $G_2$ (200 ppm). The early picking may be as a result of earliness in flowering. Similar result was also obtained by Mukhtar and Singh (2006) [22] in cowpea.

The maximum values for days to last picking (91.97 days) was observed with $G_3$ (250 ppm) while it was statistically at par with treatment $G_2$ (200 ppm). The more days took for last picking may be as a result of better pod setting. Similar result was also obtained by Mukhtar and Singh (2006) [22] in cowpea.

### 1.2 Pod Characters

The number of marketable pods plant$^{-1}$ was significantly influenced by different foliar application of $GA_3$ treatments. Significantly the highest number of marketable pods plant$^{-1}$ (44.04) and maximum number of pods plot$^{-1}$ (856.73) were observed with $G_3$ 250 ppm while it was at par with treatment $G_1$ (150 ppm). The increase in number of marketable pods plant$^{-1}$ and number of pods plot$^{-1}$ by the application of $GA_3$ might be due to increased number of branches and fruiting points, which lead to better utilization of sunlight and the plants remained physiologically more active to build up sufficient food material for developing more number of pods. These results were supported by Medhi (2000) [19] in french bean, Pandey *et al.* (2004) [26] in garden pea and Rai *et al.* (2004) [29] and Ashwini and Nawalagatti (2005) [6].

Significantly higher values for pod length (16.83 cm) was observed with $G_3$ 250 ppm while it was statistically at par with treatment $G_2$ (200 ppm) and $G_1$ (150 ppm). The increase in pod length by the application of $GA_3$ might be due to rapid cell division and increased elongation of individual cell. Similar results were reported by Medhi (2000) [19] in french bean, Pandey *et al.* (2004) [26] in garden pea, Rai *et al.* (2004) [29] in french bean and Emongor *et al.* (2007) [11] in cowpea.

Higher values for pod diameter (6.74 mm) was observed with $G_3$ 250 ppm while it was statistically at par with treatment $G_2$ (200 ppm) and $G_0$ (water spray) in statistical analysis. The increase in pod diameter with increasing concentrations of $GA_3$ might be due to rapid cell division and increased elongation of individual cell. These results were in accordance with the results of Pandey *et al*. (2004) [26] in garden pea.

### 1.3 Yield Attributes

The marketable pod yield plant$^{-1}$ was significantly influenced by different foliar application of $GA_3$ treatments. Significantly the maximum marketable pod yield plant$^{-1}$ (0.142 kg) was observed with $G_3$ 250 ppm while it was at par with treatments $G_1$ (150 ppm). The maximum marketable pod yield (8.28 t ha$^{-1}$) was observed with $G_3$ 250 ppm while it was at par with treatment $G_1$ (150 ppm) and treatment $G_2$ (200 ppm).

The increase in yield by the application of $GA_3$ might be due to that the plant growth regulator enter into the plant system and increase the net photosynthetic rate by increasing number of branches, increasing number of leaves and leaf area index which might have resulted in increased number of pods, pod length and pod diameter. Ultimately, the increased number of pods, pod length and pod diameter, resulted in the increased marketable pod yield plant$^{-1}$, marketable pod yield plot$^{-1}$, total pod yield hectare$^{-1}$ and marketable pod yield hectare$^{-1}$. Pandey *et al.* (2004) [26]; Bora and Sarma (2006) [4] in garden pea, Medhi (2000) [19]; Rai *et al.* (2004) [29]; Nawalagatti *et al.* (2009) [23] in french bean reported similar results.

The maximum numbers of picking (8.17) was observed with $G_3$ 250 ppm while it was statistically at par with the treatment $G_2$ (200 ppm) and $G_1$ (150 ppm). The increase in numbers of pickings by the application of $GA_3$ might be due to more number of leaves, more number of nodes which might have accounted for more pods at less intervals. The results are in conformity with Nowak *et al.* (1997) [24] in field bean; Govindan *et al*. (2000) [15] in soyabean; Mohandoss and Rajesh (2003) [21], Thaware *et al.* (2006) [36], Ganiger *et al.* (2003) [14] and Emongor (2007) [11] in cowpea.

### 1.4 Quality parameters

Different foliar application of $GA_3$ exhibited significant results for protein content of immature pod of cowpea during the cropping season. The significantly higher protein content of immature pod (22.45 %) was observed with $G_3$ 250 ppm. The maximum TSS (6.81$^0$Brix) was recorded with $G_3$ 250 ppm while it was statistically at par with treatment $G_2$ (200 ppm) and $G_0$ (water spray). Increase in protein content by the application of plant growth regulators might be due to increased uptake of nutrient particularly nitrogen from the soil and its further assimilation led to the synthesis of protein. Bioregulators are known to promote the metabolism of assimilates or food materials by enhancing the various enzymatic activities leading to the production or conversion into mobile amino acids (Akazawa and Miyata, 1982). Similar results were reported by Pandey *et al.* (2004) [26]; Bora and Sarma (2003) [3] in garden pea and Kaya *et al*. (2010) [16] in chickpea.

## 2. Response of foliar application CCC

### 2.1 Growth Characters

The effect of foliar application of CCC on days to 50 % flowering, plant height at final picking, days to first picking, days to last picking and primary branches plant$^{-1}$ at final picking, were found significant during the period of investigation. The minimum days to 50 % flowering (44.40 days) was recorded under the treatment $C_0$ (water spray) followed by treatment $C_2$ (300 ppm) and treatment $C_1$ (200 ppm). The minimum days to 50% flowering by application of CCC were might be due to suppression of vegetative growth which leads to less demand for food materials synthesized by treated plants.

The maximum plant height at final picking (60.34 cm) was recorded under the treatment $C_0$ (water spray) while it was at par with treatment $C_1$ (200 ppm) and $C_2$ (300 ppm). Reduction in plant height with CCC application could be due to its effect in reducing cell division, cell expansion in the sub-apical meristem and synthesis of diffusible endogenous growth substances (Cathey, 1964) [9]. Similar results were reported by Sharma and Lashkari (2009) [35] in cluster bean.

Significantly the minimum values for days to first picking (50.21 days) was observed with $C_3$ 400 ppm while it was statistically at par with the treatment $C_2$ (300 ppm) and $C_1$ (200 ppm). The decrease in number of days first picking by CCC application might be due to restriction of growth by CCC application presumably altered the metabolism and created conditions conducive to early flower formation.

The maximum values for days to last picking (91.25 days) was observed with $C_0$ water spray while it was statistically at par with treatment $C_1$ (200 ppm) and $C_2$ (300 ppm). The more days took for last picking may be as a result of better pod setting. Similar result was also obtained by Mukhtar and Singh (2006) [22] in cowpea.

### 2.2 Pod Characters

The highest number of marketable pods plant$^{-1}$ (43.86) and the number of pods plot$^{-1}$ (854.60) were observed with $C_1$ 200 ppm which was followed by treatment with $C_2$ (300.ppm). The increased number of pods plant$^{-1}$ and the number of pods plot$^{-1}$ by the application of cycocel might be due to an increase in the number of branches and number of leaves which were physiologically more active to produce more number of fruits. These results are in conformity with the results reported by Reshmi and Gopalakrishnan (2004) in yard long bean; Ganiger *et al.* (2002) [13] and Thaware *et al.* (2006) [36] in cowpea.

Significantly higher values for pod length (16.79 cm) was observed with $C_0$ water spray while it was statistically at par with treatment $C_1$ (200 ppm) and $C_2$ (300 ppm). The reduction in pod length by the application of cycocel might be due to a retarded cell division and cell elongation. These results were supported by Arora *et al.* (1990) [4] in Okra and Reshmi and Gopalakrishnan (2004) in yard long bean.

Different foliar application of CCC exhibited significant results for pod diameter in cowpea during the cropping season. The higher values for pod diameter (6.75 mm) was observed with $C_2$ 300 ppm while it was at par with treatments $C_3$ (400 ppm) and $C_1$ (200 ppm) The increase in pod diameter by the application of cycocel might be due to retarded cell elongation. Arora *et al*. (1990) [4] in okra, Arora and Dhankar (1992) [3] in okra and Kokare *et al*. (2006) [17] in okra reported similar results.

### 2.3 Yield Attributes

The marketable pod yield plant$^{-1}$ and The marketable pod yield per hectare were significantly influenced by different foliar application of CCC treatments. Significantly the maximum marketable pod yield plant$^{-1}$ (0.140 kg) and the maximum marketable pod yield (8.03 t ha$^{-1}$) were observed with $C_1$ 200 ppm while it was followed by treatments $C_2$ (300 ppm). The increase in yield by the application of cycocel might be due to reduced plant height and increased branching resulting in diversion of food material for the improvement of flowering and fruiting (Kuraishi and Muri, 1962). Similar results were reported by Reshmi and Gopalakrishnan (2004) in yard long bean, Bora and Sarma (2006) [4] in pea and Sharma and Lashkari (2009) [35] in cluster bean.

The maximum numbers of picking (8.08) was observed with $C_1$ 200 ppm while it was statistically at par with the treatment $C_0$ (water spray) and $C_2$ (300 ppm). The increase in numbers of picking might be due to more number of nodes which might have accounted for more pods at less intervals of time. These results were in line Prasad and Srihari (2008) [28] with cycocel in okra.

### 2.4 Quality parameters

Different foliar application of CCC exhibited significant results for protein content of immature pod of cowpea during the cropping season. The higher protein content of immature pod (22.41 %) was observed with $C_3$ 400 ppm. The significantly maximum TSS (6.69$^0$Brix) was observed with $C_3$ 400 ppm while it was at par with treatment $C_2$ (300 ppm) and $C_1$ (200 ppm). The growth regulator treatments increased the vigorous root system resulting in greater uptake of nitrogen and other nutrients which probably reflected in the increased protein content as well as dry weight of fruits and thereby decreasing the moisture percentage. This is in conformity with results of Ganiger *et al.* (2002) [13] in cowpea, Anamika and Dhaka (2003) [2]; Bora and Sarma (2006) [4] in pea.

### 3. Response of interaction of $GA_3$ and CCC

Interaction effect of foliar application of $GA_3$ and CCC on various growth parameters pod characters, yield attributes and quality parameters were found non-significant in statistical analysis.

**Table 2:** Response of $GA_3$ and CCC on various Growth parameters Pod characters of Cowpea cv. AVCP-1

| Treatments | Number of days to 50% flowering | Plant height at final picking (cm) | Number of days to first picking | Number of days to last picking | Number of marketable pods plant$^{-1}$ | Number of pods plot$^{-1}$ | Pod length (cm) | Pod diameter (mm) |
|---|---|---|---|---|---|---|---|---|
| **Gibberellic acid** | | | | | | | | |
| $G_0$ - Water spray | 44.58 | 55.90 | 51.58 | 85.37 | 37.62 | 773.05 | 15.14 | 6.36 |
| $G_1$ - $GA_3$ 150 ppm | 45.13 | 58.33 | 49.84 | 87.35 | 41.35 | 825.77 | 16.08 | 6.09 |
| $G_2$ - $GA_3$ 200 ppm | 46.49 | 59.59 | 52.06 | 89.33 | 39.95 | 810.61 | 16.74 | 6.58 |
| $G_3$ - $GA_3$ 250 ppm | 46.95 | 60.68 | 54.62 | 91.97 | 44.04 | 856.73 | 16.83 | 6.74 |
| S.Em.± | 0.65 | 1.02 | 1.13 | 1.47 | 1.14 | 15.64 | 0.40 | 0.15 |
| C.D. at 5% | 1.88 | 2.96 | 3.27 | 4.24 | 3.29 | 45.18 | 1.17 | 0.43 |
| **Cycocel** | | | | | | | | |
| $C_0$ - Water spray | 46.91 | 60.34 | 54.79 | 91.25 | 39.66 | 798.92 | 16.79 | 6.03 |
| $C_1$ - Cycocel 200 ppm | 46.60 | 59.62 | 52.11 | 89.95 | 43.86 | 854.60 | 16.67 | 6.43 |
| $C_2$ - Cycocel 300 ppm | 45.23 | 58.16 | 50.98 | 87.35 | 41.10 | 715.81 | 16.06 | 6.75 |
| $C_3$ - Cycocel 400 ppm | 44.40 | 56.38 | 50.21 | 85.48 | 38.35 | 796.85 | 15.28 | 6.56 |
| S.Em.± | 0.65 | 1.02 | 1.13 | 1.47 | 1.14 | 15.64 | 0.40 | 0.15 |
| C.D. at 5% | 1.88 | 2.96 | 3.27 | 4.24 | 3.29 | 45.18 | 1.17 | 0.43 |
| **G × C interaction** | | | | | | | | |
| S.Em.± | 1.31 | 2.05 | 2.26 | 2.94 | 2.28 | 31.28 | 0.81 | 0.30 |
| C.D. at 5% | NS | NS | NS | NS | NS | NS | NS | NS |
| C.V. % | 4.94 | 6.05 | 7.53 | 5.75 | 9.68 | 6.64 | 8.64 | 8.09 |

**Table 3:** Response of $GA_3$ and CCC on Yield attributes and Quality parameters of Cowpea cv. AVCP-1

| Treatments | Marketable pod yield plant$^{-1}$ (kg) | Marketable pod yield (t ha$^{-1}$) | Numbers of picking | Protein content of immature pod (%) | TSS ($^0$Brix) |
|---|---|---|---|---|---|
| **Gibberellic acid** | | | | | |
| $G_0$ - Water spray | 0.126 | 6.69 | 7.08 | 21.11 | 6.29 |
| $G_1$ - $GA_3$ 150 ppm | 0.135 | 8.01 | 7.58 | 21.65 | 5.94 |
| $G_2$ - $GA_3$ 200 ppm | 0.130 | 7.72 | 7.92 | 22.03 | 6.53 |
| $G_3$ - $GA_3$ 250 ppm | 0.142 | 8.28 | 8.17 | 22.45 | 6.81 |
| S.Em.± | 0.003 | 0.22 | 0.23 | 0.30 | 0.19 |
| C.D. at 5% | 0.008 | 0.63 | 0.65 | 0.86 | 0.56 |
| **Cycocel** | | | | | |
| $C_0$ - Water spray | 0.129 | 7.53 | 7.83 | 21.19 | 5.91 |
| $C_1$ - Cycocel 200 ppm | 0.140 | 8.06 | 8.08 | 21.67 | 6.41 |
| $C_2$ - Cycocel 300 ppm | 0.135 | 7.89 | 7.75 | 21.97 | 6.56 |
| $C_3$ - Cycocel 400 ppm | 0.130 | 7.22 | 7.08 | 22.41 | 6.69 |
| S.Em.± | 0.003 | 0.22 | 0.23 | 0.30 | 0.19 |
| C.D. at 5% | 0.008 | 0.63 | 0.65 | 0.86 | 0.56 |
| **G × C interaction** | | | | | |
| S.Em.± | 0.006 | 0.44 | 0.45 | 0.60 | 0.39 |
| C.D. at 5% | NS | NS | NS | NS | NS |
| C.V. % | 7.59 | 9.92 | 10.16 | 4.74 | 10.50 |

**Table 4:** Economics of different treatments

| Treatments | Pod Yield (t ha$^{-1}$) | Gross realization (₹/ha) | Common cost (₹/ha) | Treatment cost (₹/ha) | Total cost (₹/ha) | Net realization (₹/ha) | B.C.R |
|---|---|---|---|---|---|---|---|
| **A. Gibberellic acid** | | | | | | | |
| $G_0$- Water spray | 6.69 | 133800 | 49843 | - | 49843 | 83957 | 1.66 |
| $G_1$- $GA_3$ 150 ppm | 8.01 | 160200 | 49843 | 9810 | 59653 | 100547 | 1.68 |
| $G_2$- $GA_3$ 200 ppm | 7.72 | 154400 | 49843 | 13080 | 62923 | 91477 | 1.45 |
| $G_3$- $GA_3$ 250ppm | 8.28 | 165600 | 49843 | 16350 | 66193 | 99407 | 1.50 |
| **B. Cycocel** | | | | | | | |
| $C_0$- Water spray | 7.54 | 150800 | 49843 | - | 49843 | 100957 | 2.02 |
| $C_1$- CCC 200 ppm | 8.06 | 161200 | 49843 | 288 | 50131 | 111069 | 2.21 |
| $C_2$- CCC 300 ppm | 7.89 | 157800 | 49843 | 432 | 50275 | 107525 | 2.13 |
| $C_3$- CCC 400 ppm | 7.22 | 144400 | 49843 | 576 | 50419 | 93981 | 1.86 |

## 4. Conclusion

The results obtained from the investigation, it is concluded that treatment $GA_3$ 250 ppm and CCC 200 ppm were recorded the maximum number of marketable pods per plant, number of pods per plot, marketable pod yield per plant, marketable pod yield in hectare and TSS. Maximum primary branches per plant at final picking and protein content were found in treatment $GA_3$ 250 ppm and CCC 400 ppm. While higher net realization and higher B.C.R. observed in treatment $GA_3$ 150 ppm and CCC 200 ppm, it is advisable to use either $GA_3$ 150 ppm or CCC 200 ppm as foliar application in cowpea cv. AVCP-1.

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