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Effect of PGRs on Quality and Yield Traits of Vegetable Cowpea [*Vigna unguiculata* (L.) Walp.]

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A B S T R A C T

A field experiment was carried out, at the Vegetable Research Farm, RHRS of the NAU, Navsari during Summer 2020 on cv. AVCP 1. The experiment was conducted in randomized block design (RBD) with three replications, which included 13 treatments. The results revealed that application of CCC 300 µl l^{-1} recorded higher values for quality and yield parameters namely, chlorophyll content of leaf at second (1676.22 mg 100 g^{-1})and sixth picking (1656.18 mg 100 g^{-1}) and chlorophyll content of pod at second (116.66 mg 100 g^{-1}) and sixth picking (116.34 mg 100 g^{-1}), pod yield (t ha^{-1}) (10.87 tonne), marketable pod yield $plant^{-1}$(0.160 kg) and marketable pod yield (t ha^{-1}) (10.44 tonne), whereas protein content of immature seed (%), moisture content of pod (%), crude fibre (%), TSS (°B), Harvest Index (%) and number of pickings were found non-significant. From the economic point of view and based on green pod yield, for securing maximum return, foliar application of CCC 300 µl $l^{-1}$was found superior with highest B:CR value of 2.2 followed by T_{11} (B:CR value of 2.1).

Introduction

Amongst horticultural crops, vegetables have gained importance not only in providing better per unit returns but also in providing nutritional security. The role of vegetables as a major source of phytonutraceuticals like vitamins, minerals, antioxidants and fibers are being well recognized in a balanced diet and provide source of income to farmers, seed producers, processors and traders (Sable *et al.*, 2020).

India is the second largest producer of vegetable in the world after China producing around 188 million tonne from just 10.5

million hectare area. Though pulses are grown in both *Kharif* and *Rabi* seasons, *Rabi* pulses contribute more than 60 per cent of the total production. In India total area under cowpea cultivation is 1.5 million hectare whereas, in Gujarat it is cultivated commercially in an area of 0.5 lakh hectare (Anonymous, 2020).

Cowpea (*Vigna unguiculata* (L.) Walp.), 2n=2x=22 belongs to family Fabaceae, popularly known as *chauli* is an important legume vegetable crop. It is grown in tropics for its tender green pods and shelled immature seeds used as vegetable and dry seeds used as pulse. It is grown for immature pods and mature grains.

The haulms are also fed to livestock. Cowpea is known as drought hardy nature, its wide and droopy leaves keeps soils and soil moisture conserved due to shading effect.

It is also known as black-eyed pea or southern pea *etc*. and has multiple uses like food, feed, forage, fodder, green manuring and vegetable (Saravaiya *et al.*, 2014).

Though, the PGRs have great potential, its application and accurate assessments *etc.* have to be judiciously planned in terms of optimal concentration, stage of application, species specificity and seasons.

In 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 t ha^{-1} (Sharma and Lashkari, 2009).

These synthetic PGRs are put into several uses in horticulture, one of them is to increase crop yield and improve quality. The growth behavior of many plants could be modified or controlled by applying small amount of plant growth regulators, either by seed soaking, root dipping or whole plant spray.

Among several growth substances, gibberellins and auxins are very promising and these are being used on large scale in number of vegetable crops.

The growth promoters like NAA and 2,4-D enhance the source-sink relationship and modified translocation of photosynthates, which will help in better retention of flowers and fruits and seed filling at the later stages of crop growth. The influence of CCC on the leaf colour can be seen shortly after application.

The change in colour is due to a higher chlorophyll-synthesis. To achieve optimum vegetative growth and better translocation of phytosynthates in developing pods, the use of growth regulators appears to be an excellent tool which regulate plant growth and finally alter the plant architecture and yield improvement.

However, very rare information is available on this aspect; therefore, the aim of the present study was to investigate the response of foliar application of PGRs on growth, yield and quality of vegetable cowpea.

Hence, the research study entitled "Effect of PGRs on Quality and Yield Traits of vegetable cowpea [*Vigna unguiculata* (L.) Walp.]*"* using cultivar 'AVCP 1' was carried out at Vegetable Research Farm, Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari with the following objectives:

To evaluate the effect of foliar application of PGRs *viz*., NAA, PCPA, 2,4-D and CCC on quality parameters of vegetable cowpea

Application of PGRs *viz*., NAA, PCPA, 2,4-D and CCC on yield parameters of vegetable cowpea

Materials and Methods

A field experiment entitled "Effect of PGRs on Quality and Yield Traits of vegetable cowpea [*Vigna unguiculata* (L.) Walp.]" was laid out on cowpea during 2020 at Vegetable Research Farm, Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari.

According to agro-climatic conditions of Gujarat state, Navsari falls under 'South Gujarat Heavy Rainfall Zone, AES-III'. The climate of this zone is typically tropical and monsoonic. An average rainfall of the tract is about 1500 mm and is normally receive by second fortnight of June and cease by September end.

There were thirteen treatment *viz*. T_1 : Control (No spray), T_2 : NAA 10 mg l^{-1}, T_3 : NAA 15 mg l^{-1}, T_4 : NAA 20 mg l^{-1}, T_5 : PCPA 10 mg l^{-1}, T_6 : PCPA 15 mg l^{-1}, T_7 : PCPA 20 mg l^{-1}, T_8 : 2,4-D 0.5 mg l^{-1}, T_9 : 2,4-D 1.0 mg l^{-1}, T_{10} : 2,4-D 1.5 mg l^{-1}, T_{11} : CCC 200 µl l^{-1}, T_{12} : CCC 300 µl l^{-1} and T_{13} : CCC 400 µl l^{-1}.

Observations were recorded for different parameters. The protein content was estimated by Lowry's method as described by Sadasivam and Munickam (1991).

Moisture content was determined by oven drying the pod. The crude fibre content from pulp of cowpea immature green pods. The percentage of TSS content in the cowpea green pods of different treatments was recorded with the help of Erma made hand refractometer (range of 0 to 32).

The pulp was extracted through muslin cloth on refractometer prism and three readings were recorded and expressed in terms of percentage. Chlorophyll content of fresh leaf and pod samples of cowpea was determined by using method as described by Sadasivam and Manickam (1996).

Results and Discussion

Influence on quality parameters

Quality parameters *viz*., chlorophyll content of leaf at second and sixth picking and chlorophyll content of pod at second and sixth picking were significantly influenced by the foliar application of PGRs. Whereas Protein content of immature seed (%), moisture content of pod (%), crude fibre (%) and TSS (^{o}B) were found non-significant.

CCC 300 µl l^{-1} found best and recorded maximum chlorophyll content of leaf at second (1676.22 mg 100 g^{-1})and sixth picking (1656.18 mg 100 g^{-1}) and chlorophyll content of pod at second (116.66mg 100 g^{-1}) and sixth picking (116.34mg 100 g^{-1}).

The application of NAA and CCC at all level increases the chlorophyll content without the modification of leaf anatomy and delayed chlorophyll degradation. Significant increasing in photosynthetic area and high concentration of photosynthetic pigments increases the photosynthesis rate and efficiency which increases the concentration of chlorophyll content in leaves and pods. The delay in leaf senescence could also be attributed to higher chlorophyll content. Shinde and Jadhav (1995) have also reported that the foliar application of NAA significantly increased chlorophyll content in cowpea. Similar trend were also observed by Zewail *et al.*, (2011) in faba bean.

Influence on yield parameters

Yield parameters *viz*., marketable pod yield plant^{-1} (kg) and marketable pod yield (t ha^{-1}) were significantly influenced by the foliar application of PGRs.

Table.1 Effect of foliar application of PGRs on different traits of cow pea cv. AVCP 1.

Treatments	Protein content of immature seed (%)	Moisture content of pod (%)	Crude fibre (%)	TSS (^{o}B)	Number of marketable pods plant^{-1}	Marketable pod yield (t ha^{-1})
T_1 : Control	5.25	86.44	14.48	7.18	86.98	6.04
T_2 : NAA 10 mg l^{-1}	5.54	85.47	13.78	7.58	93.30	9.06
T_3 : NAA 15 mg l^{-1}	5.83	85.04	13.47	7.68	101.45	9.56
T_4 : NAA 20 mg l^{-1}	5.83	85.75	13.97	7.60	106.07	9.65
T_5 : PCPA 10 mg l^{-1}	5.54	86.64	14.12	7.53	70.68	4.93
T_6 : PCPA 15 mg l^{-1}	5.25	87.97	13.87	7.29	70.30	4.71
T_7 : PCPA 20 mg l^{-1}	5.54	86.28	14.42	7.40	68.84	4.57
T_8 : 2,4-D 0.5 mg l^{-1}	5.25	85.28	13.65	7.27	88.87	7.17
T_9 : 2,4-D 1.0 mg l^{-1}	5.25	85.13	14.12	7.24	92.93	7.35
T_{10} : 2,4-D 1.5 mg l^{-1}	5.25	84.23	14.15	7.44	96.33	8.37
T_{11} : CCC 200 µl l^{-1}	5.54	84.69	13.10	7.68	103.58	10.08
T_{12} : CCC 300 µl l^{-1}	6.13	83.59	13.00	7.77	112.93	10.44
T_{13} : CCC 400 µl l^{-1}	5.83	84.54	13.08	7.70	110.98	9.79
S.Em.±	0.40	1.04	0.37	0.14	3.73	0.55
C.D. at 5 %	NS	NS	NS	NS	10.89	1.61

Table.2 Effect of foliar application of PGRs on Chlorophyll content of leaf and pod of cow pea cv. AVCP 1.

Treatments	Chlorophyll content of leaf at second picking (mg 100 g^{-1})	Chlorophyll content of leaf at sixth picking (mg 100 g^{-1})	Chlorophyll content of pod at second picking (mg 100 g^{-1})	Chlorophyll content of pod at sixth picking (mg 100 g^{-1})
T_1 : Control	1425.92	1408.97	97.58	95.84
T_2 : NAA 10 mg l^{-1}	1560.56	1586.92	113.59	111.82
T_3 : NAA 15 mg l^{-1}	1631.30	1594.81	114.31	112.92
T_4 : NAA 20 mg l^{-1}	1635.22	1600.14	115.00	114.11
T_5 : PCPA 10 mg l^{-1}	1441.39	1442.37	104.59	102.35
T_6 : PCPA 15 mg l^{-1}	1444.64	1441.32	103.95	106.07
T_7 : PCPA 20 mg l^{-1}	1442.13	1418.91	103.71	101.79
T_8 : 2,4-D 0.5 mg l^{-1}	1498.82	1456.85	108.73	109.90
T_9 : 2,4-D 1.0 mg l^{-1}	1533.08	1486.53	108.78	110.17
T_{10} : 2,4-D 1.5 mg l^{-1}	1553.28	1499.35	111.77	112.96
T_{11} : CCC 200 µl l^{-1}	1602.32	1586.35	115.39	114.85
T_{12} : CCC 300 µl l^{-1}	1676.22	1656.18	116.66	116.34
T_{13} : CCC 400 µl l^{-1}	1665.08	1611.03	115.90	115.33
S.Em.±	21.27	38.50	3.00	3.25
C.D. at 5 %	62.06	112.36	8.75	9.48

Table.3 Economics of different treatments (Rs. ha^{-1})

Treatments	Pod yield (t ha^{-1})	Treatment Cost	Operational Cost	Total Cost	Gross Return	Net Return	B:CR
T_1 : Control	6.04	0	76765	88090	181200	93110	**1.1**
T_2 : NAA 10 mg l^{-1}	9.06	396	76765	94148	271800	177652	**1.9**
T_3 : NAA 15 mg l^{-1}	9.56	440	76765	95130	286800	191670	**2.0**
T_4 : NAA 20 mg l^{-1}	9.65	484	76765	95343	289500	194157	**2.0**
T_5 : PCPA 10 mg l^{-1}	4.93	344	76765	86353	147900	61547	**0.7**
T_6 : PCPA 15 mg l^{-1}	4.71	362	76765	85958	141300	55342	**0.6**
T_7 : PCPA 20 mg l^{-1}	4.57	380	76765	85714	137100	51386	**0.6**
T_8 : 2,4-D 0.5 mg l^{-1}	7.17	310	76765	90518	215100	124582	**1.4**
T_9 : 2,4-D 1.0 mg l^{-1}	7.35	311	76765	90857	220500	129643	**1.4**
T_{10} : 2,4-D 1.5 mg l^{-1}	8.37	312	76765	92770	251100	158330	**1.7**
T_{11} : CCC 200 µl l^{-1}	10.08	375	76765	96040	302400	206360	**2.1**
T_{12} : CCC 300 µl l^{-1}	10.44	419	76765	96759	313200	216441	**2.2**
T_{13} : CCC 400 µl l^{-1}	**9.79**	**442**	**76765**	**95563**	**293700**	**198137**	**2.1**

Fig.1 Effect of different treatments on chlorophyll content of leaf at second and sixth picking (mg 100 g^{-1}) of vegetable cowpea cv. AVCP 1

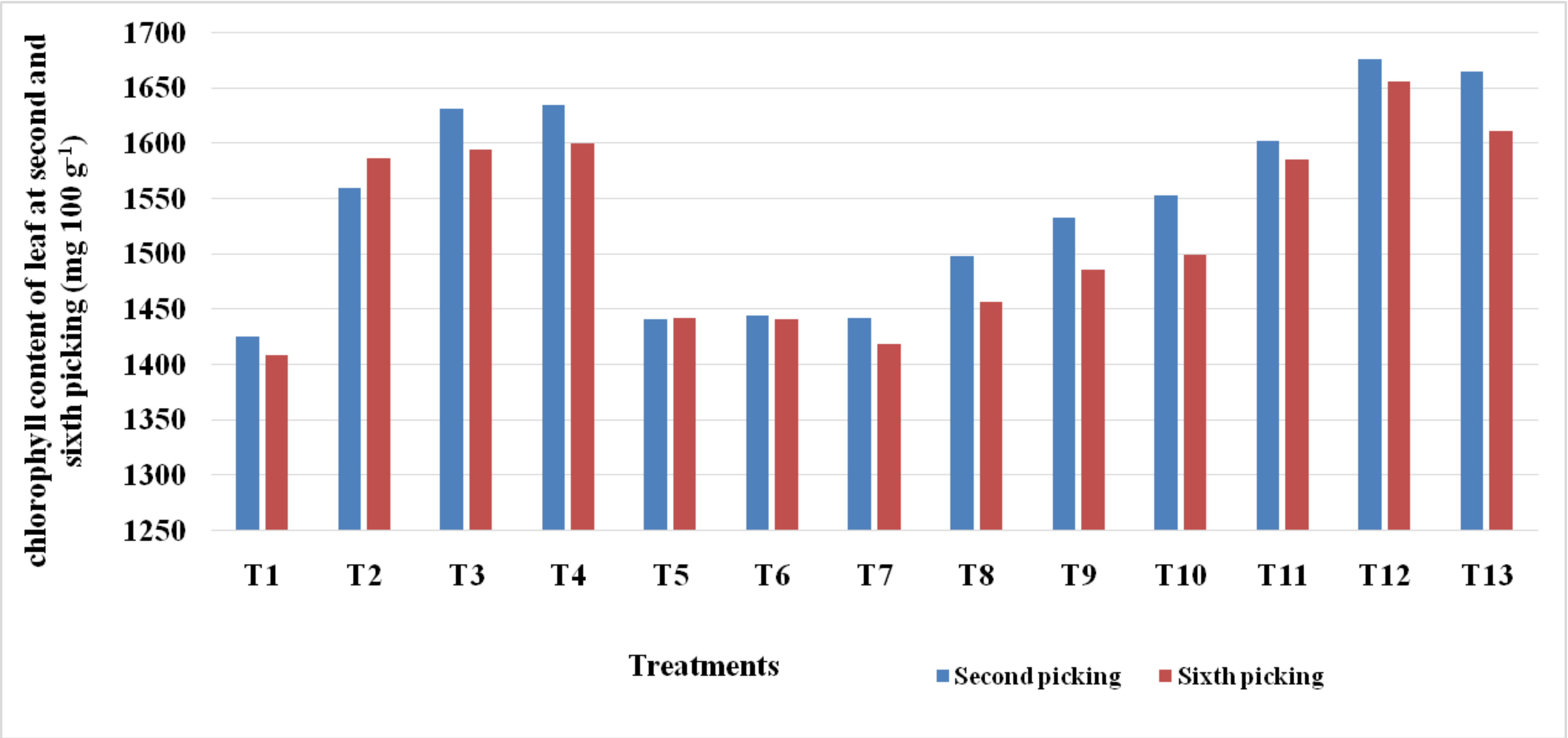
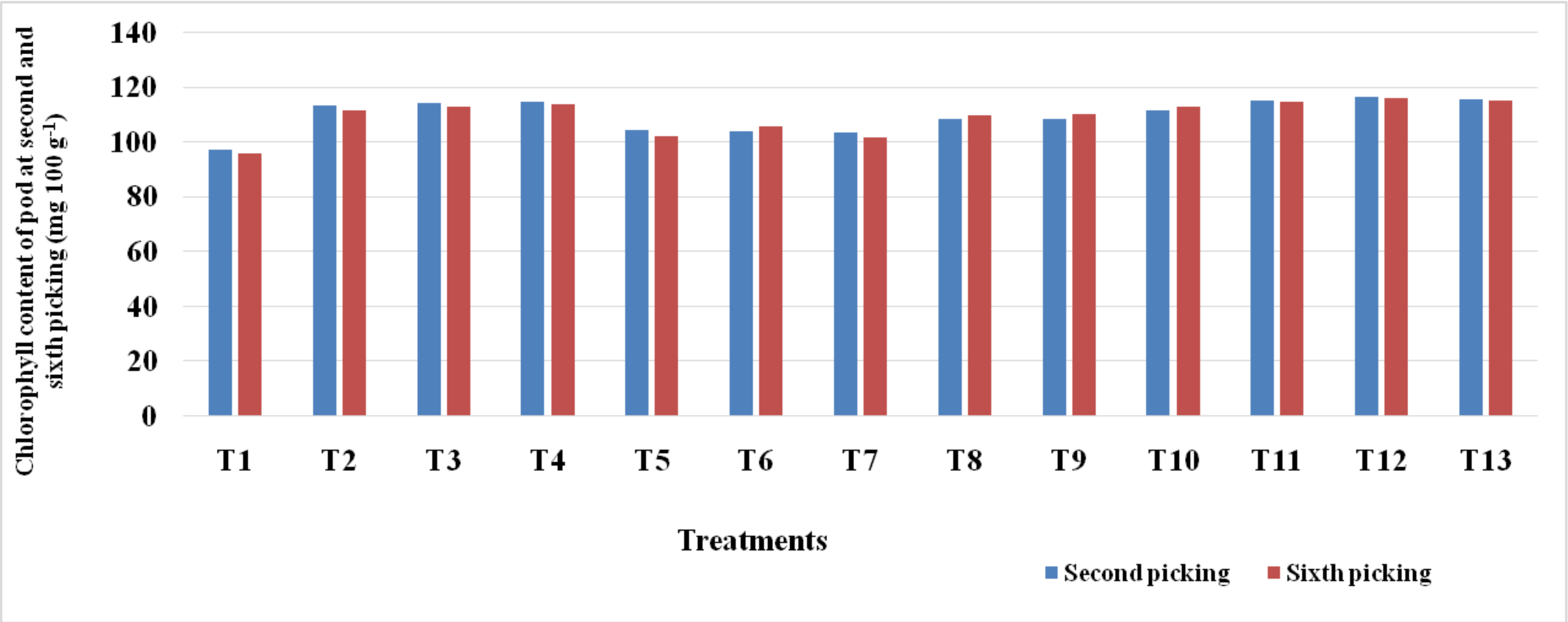


Fig.2 Effect of different treatments on chlorophyll content of pod at second and sixth picking (mg 100 g^{-1}) of vegetable cowpea cv. AVCP 1



CCC 300 µl l^{-1} found best and recorded maximum marketable pod yield $plant^{-1}$(0.160 kg) and marketable pod yield (t ha^{-1}) (10.44 ton). Increased yields in these treatments can be explained based on the enhanced vegetative growth, increased fruit sizes and higher fruit numbers.

Exogenous application of plant growth regulators might be causes a greater accumulation of carbohydrates owing to photosynthesis which accelerate the overall growth of plant result in more number of pods and increase size of seeds ultimately more yield with good quality. In particular, all concentrations of NAA and CCC showed increased fruit numbers and per plant yield, which may be because of a reduction in flower drop and fruit abortion thereby bring about an improvement in yield potential. Similar results were also found by Resmi and Gopalakrishnan (2004) in yard long bean; Sharma and Lashkari (2009) in cluster bean; Kumar *et al.*, (2003) in chickpea; Das and Prasad (2003) in mung bean; Desai and Deore (1985) in cowpea and Patil *et al.*, (2005) in green gram.

Influence on Economics

CCC 300 µl l^{-1} registered the highest net profit 2,16,441 Rs. ha^{-1} with B:CR value of 2.2 as compared to rest of the treatment, followed by T_{11} (B:CR of 2.1). Whereas, treatment T_6 (PCPA 15 mg l^{-1}) and T_7 (PCPA 20 mg l^{-1}) recorded the lowest net realization 55,341.85 and 51,386.35 Rs. ha^{-1} respectively, with lowest B:CR value of 0.6.

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