Original Research Article

Influence of growth regulators application on seed development and maturation inpigeonpea (*Cajanus cajan*(L.)

ABSTRACT

The experiment was carried outat National Pulses Research Centre (NPRC), Vamban, Tamil Nadu Agricultural University to assess the effect of growth regulators foliar sprayon seed development and maturation in PigeonpeaVBN(Rg) 3. Plant growth regulators *viz.,*GA_3 (200 ppm) andchlormequat chloride(CCC)200 ppmwere sprayed at vegetative (65 DAS) and flowering stage (80 DAS). The plants without any foliar spraying treatment considered as control. When 50 percent of the plants in a population have reached bud initiation stage, the buds were tagged and collected at five days interval from 5th day upto45th days after initiation (DAI). The variation in pod colour, changes in pod length and weight, seed fresh and dry weight, moisture content, germination and seedling vigourwere recorded at regular intervals of five days up to 45 days after flower initiation. The results revealed thatthemaximum pod length, fresh and dry weight of pod and seed, seed germination and seedling vigour was observed in pigeonpea at 30 days after floral initiation (DAI) in chlormequat chloride (CCC)200ppm foliar treatment. The control *i.e.* without any foliar treatment had attained the physiological maturity at 35 DAI by recording all the physiological parameters *viz.* maximum pod length, fresh and dry weight, seed germination and seedling vigour. In pigeonpea, application of CCC @ 200 ppm as foliar treatmentleadsto attain physiological maturity at 30 days after initiation of flowering (DAI) by recording the highest seed weight, germination and seedling dry weight over control.

Keywords: Pigeonpea, Foliar spray, CCC, development and maturation, germination, vigour

INTRODUCTION

Pigeonpea(*Cajanus cajan*(L.)belongs to the familyfabaceaeis drought resistant and can be grown in area with less than 650mm annual rainfall and with low input requirement. Protein content of thepigeonpeaseeds is about 2-3 times more than the cereals. In addition to its nutritional value it also has a unique property of maintaining andrestoringsoil fertility through biological nitrogen fixation and improvement ofphysicalproperties of the soil by virtue of its deep root system. One of the chief factors that affect seed quality during storage and its performance under field conditions is the maturity stage at which the crop is harvested. At physiological maturity, seed attains maximum vigour and viability (Khattra and Singh, 1995) and the changes that occur beyond the physiological maturity would be only dehydration without accumulation of reserves. Hence, a precise determination of physiological maturity will permit an accurate measure of seed filling period. Dehydration of seeds on the mother plant till harvestable maturity may not bring any additional input in seed quality and sometimes it may even be deleterious to seed quality (Ellis *et al.,* 1987).

Harvesting at the right time has commercial implications as it permits quick harvesting at appropriate time, resulting in better field management particularly in multi cropping system. In addition, these would result in reducing losses due to biological and climatic hazards. Though there are contradictions about maximum seed quality beyond physiological maturity in some crops (Zanakis*et al.,* 1994),optimum time of harvest on the basis of physiological maturity has been precisely determined in soybean (Crookston and Gill, 1978), sunflower (Dorell, 1978), cotton (Changade*et al.,* 1990)and amaranthus (Menaka and Balamurugan, 2003) and several other crops. Plant growth regulators (PGR's) are known to improve physiological efficiency including photosynthetic ability of plant and offer significant role in realizing higher crop yields. The PGR's are also known to enhance the source sink relationship and stimulate the translocation of photo assimilates, thereby increase the productivity.Gibberellic acid (GA3) is one of the most advantageous growth regulator and has been utilized to influence different plant developmental processes, such as seed germination, increasing plant height, increasing the number of flowers, inducing flowering and sex expression and breaking dormancy (Rupali et al., 2023).Withthis background, the presentinvestigationwas carried out to assess the effect of growth regulators application on physiological maturity in pigeopea.

MATERIALS AND METHODS

The investigation was carried to assess the influence of growth regulators on seed development and maturation in pigeonpeaVBN (Rg) 3at National Pulses Research Centre (NPRC), Vamban, Tamil Nadu Agricultural University during 2017-18. Seeds of pigeonpea VBN (Rg) 3 acquired from NPRC, Vambananddried to a uniform moisture content in a drying cabinet at 30 $\pm$ 1^{0}C for four days to reach 9.0 % moisture content and used for this research.

Sowing was done in Randomized Block Design withfour replications during *Rabi* 2017-18 (October-February) at experimental field of National Pulses Research Centre, Vamban, Tamil Nadu (11° 30'North and, 79°26'East and altitude of 122 m above MSL). The soil texture of the experimental field was red lateritic with acidic pH 4.7-6.5. The recommended crop management practices were followed. Plant growth regulators *viz.,*GA_3 (200 ppm) and chlormequat chloride (CCC)@ 200 ppm were sprayed at vegetative stage(65 Days After Sowing (DAS)and flowering stage (80 DAS). The plants withoutany foliar spraying considered as control. Todocument the optimum physiological maturity stage, four replications for treatment and control were adopted,the plants in the rows were observed daily for bud initiation. When 50 percent of the plants in a population have reached bud initiation stage, the buds were tagged with 4 x 4 cm white-coloured tags (approx. 200 buds) and collected at five days interval from 5th day upto45thdays after flower initiation (DAI).The variation in pod colour changes was recorded at regular intervals of five days. The length of the pod was measured in cm with a thread and the mean arrived. Fresh weight was recordedby weighing individual pod in g using an electronic balance. The pod used for fresh weight were dried under ambient conditions for five days followed by drying at 80^0C for 16 h, weighed in g using electronic balance and arrived the dry weight. The seeds extracted from individual pod were weighed in g using electronic balance and fresh weight of seed arrived. The seed used for fresh weight were dried at 80^0C for 16 h., weighed in g using an electronic balance and calculated the dryweightof seeds. The seed moisture content was estimated using hot air oven at 105^0C for 16 $\pm$ 1h (ISTA, 2015).

The germination test was carried out with four replicates of hundred seeds each using paper medium in a germination room maintained at 25 ± 2 °C temperature and 95 ± 3 per cent RH, illuminated with fluorescent light(ISTA, 2015). After the test period of seven days, the seedlings were evaluated. The mean germination was determined and reported as a percentage based on the mean number of normal seedlings produced. Root length of all the normal seedlings from the germination test was measured from collar region to the root tip, the mean recorded and expressed in cm and shoot length of all normal seedlings was measured from collar region to the apex, the mean recorded and expressed in cm. For dryweight measurement, all the normal seedlings used for growth measurements were placed in paper cover and dried under shade for 24h. and then in a hot air oven maintained at 80^0C for 16h. The dried seedlings were cooled in desiccator containing silica gel and the weight recorded using an electronic balance and the dry weight was expressed in g10 seedlings^{-1}.

The results of experiments were subjected to an Analysis of Variance and treatment differences tested (t test) for significance (Gomez and Gomez, 1984). Wherever necessary, the percentage values were transformed in to arc sine values prior to statistical analysis.

RESULTS AND DISCUSSION

The pod colourwasdark green at five days after initiation (DAI), turned to darkgreen with slight purple stripes at 15 DAI,light yellowwithpurple stripes at 25 DAI, browncolour at 30 DAI and finally became dark brown at 40 DAI and blackish brown at 45 DAI in CCC @ 200 ppm foliar spray treatment (Table 1).Whereas pods in control plant and GA_3@ 200 ppm foliar spray treatment turned to brown colour at 35 DAI and dark brown at 45 DAI.In control, the mean pod length increased from 0.73 cm at five DAI to 4.80 cm at 35 DAI.   Thereafter the length decreased to 4.57cm at 45 DAI (Table 1). Whereas in CCC @ 200 ppm foliar spray treatment, the mean pod length increased from 0.81 cm at five DAI to 5.26cm at 30 DAI thereafter it decreased to 5.04cm and in GA_3@ 200 ppm foliar spray treatment,the maximumpodlength was 5.06 cm at35 DAI and thereafter it reduced to 4.85 cm at 45 DAI (Table 1).   The fresh weight of the developing pod increased considerably from 0.022 g at five DAI to 0.846 g at 35 DAI in control plant and thereafter the fresh weight decreased to 0.786 g at 45 DAI (Table 2). The CCC @ 200 ppm foliar spray treatment recorded the maximum pod fresh weight of 0.896g at 30 DAI when compared to GA_3@ 200 ppm (0.864 g) and control (0.757g) (Table 2.). The dry weight of the pod increased from 0.020 g at five DAI, attained the maximum of 0.627 g at 30 DAI and decreased to 0.602 at

45 DAI in CCC @ 200 ppm foliar spray treatment. The GA_3@ 200 ppm foliar treatment also registered the maximum pod dry weight (0.611g) at 30 DAI whereas in control, the maximum pod dry weight (0.462) was recorded at 35 DAI but the effect was lesser when compared to the results of foliar treatments (Table 2).

The seed development was startedat10 DAI in all the treatments. Fresh weight of developing seed increased progressively from 0.026 g at 10 DAI to the maximum of 0.756 g at 35 DAI in control, 0.034g at 10 DAI to 0.786g at 30 DAI in CCC @ 200 ppm foliar spray treatment and 0.030 g to 0.684g at 30 DAI in GA_3@ 200 ppm foliar treatment and thereafter decreased the seed fresh weight in all the treatments(Table 3). The maximum seed dry weight of 0.495g was recorded in CCC @200 ppm foliar spray treatment at 30 DAI which was followed by GA_3@ 200 ppm foliar treatment (0.471g) whereas control recorded the seed dry weight of only 0.486g at 35 DAI (Table 3).

The highest moisture content of the seed was observed at 15 DAI(46.07% in control, 45.47% in CCC @ 200 ppm and 45.86% in GA_3@ 200 ppm)and then the moisture content gradually reduced and reached the lowest at 45 DAI in all the treatments (Fig.1).The first germination was observed at 15 DAI in CCC @ 200 ppm (12%) and GA_3@ 200 ppm (8%) but in control the germination was started only at 20 DAI (14%) (Fig2.). The maximum germination of 91% was recorded in CCC @ 200 ppm foliar treatment followed by GA_3@ 200 ppm (88%) whereas the control recorded only 85% at 35 DAI. The germination was maintained with minimum reduction up to 40 DAI and after that the germination was reduced in all the treatments(Fig 2.).In control, the root length of seedlings increased gradually from 8.44 cm at 20 DAI to 19.13 cm at 35 DAI and decreased at later stages. The lengthiest root was observed in CCC @ 200 ppm foliar treatment (20.32 cm) followed by GA_3@ 200 ppm (19.64 cm) at 30 DAI(Table 3). Similar trend of result was also observed for shoot length. The maximum shoot length was observed in CCC @ 200 ppm foliar treatment (25.47 cm) followed by GA_3@ 200 ppm (23.77 cm)at 30 DAI whereas the control recorded the shoot length of 23.17cm at 35 DAI (Table 3). In CCC @ 200 ppm foliar treatment, the seedling dry matter accumulation increased gradually from 0.018 g at 15 DAI to 0.422 g at 30 DAI and thereafter decreased and attained the lowest value of 0.403 g at 45 DAI (Fig.3). The GA_3@ 200 ppm treatment recorded the dryweight of 0.403g at 30 DAI when compared to control which recorded 0.409 g of dryweight at 35 DAI(Fig.3).

In the present study, the maximum pod length, fresh and dry weight was evident in pigeonpeaat 30 days after floral initiation (DAI) in CCC @ 200 ppm foliar treatment. At this stage, the seed fresh weight, dry weight and germination were maximum. In addition, the seedling length and dry matter production was also greater which was followed by GA_3@ 200 ppm treatment. The moisture content declined considerably. Beyond this stage, the seed quality parameters in terms of dry weight, germination, root length and seed length did not bring any added advantage. The control *i.e.* without any foliar treatment had attained the physiological maturity by recording all the physiological parameters *viz.* maximum pod length, fresh and dry weight, germination and seedling vigour at 35 DAI. Thegrowth regulators foliar treatment requires lesser number ofdays for attaining physiological maturity (30 DAI) with maximum seed quality parameters whereas control plants took five days higher for physiological maturity (35 DAI).It isinferred from this study that the phenological stages *viz.*, pod initiation, podfilling and physiological maturity are early due to use ofplant growth regulators as foliar treatment at vegetative and flowering stage when compared tocontrol. Growth regulators play a significant role in modifying growth and flowering of pigeonpea.GA have been classically implicated in a few crucial physiological responses, such as the regulation of plant stature and the relevance extends beyond their effect on stem elongation, germination and flowering (2022). Application of GA3 200 ppm significantly increased seed yield and its attributes of sesame *viz.*, number of capsule per plant, number of seeds per capsule, biological yield, harvest index and oil content (Hadia et al., 2021).

Plant growth regulators change both morphology and physiology of crop and also capable of redistribution of photo- assimilates into different organs of the plant and thereby bring about better source-sink relationship and yield improvement (Vanitha and Kathiravan, 2019).When growth regulator is used in appropriate concentration influences the plant architecture in a typical fashion and improve the yield potential.Similar reports have been made by Guimaras*et al*. (2015) in pigeonpea, Sheng *et al*. (2019) in cotton, Garai and Datta(2003) in greengram, Berova and Zlatev (2000) in tomato. Foliar application of Brassinolide@0.25 ppm significantly increased flower:fruit ratio, pollen viability, pod weight, pod length and reduced days to maturity (65 days) in greengram (Dilip *et al*., 2017).

CONCLUSION

The results of the present investigation are suggestive of the fact that application of CCC @ 200 ppm as foliar treatment at vegetative stage (65 days after treatment) and flowering stage (80 days after treatment) favors the seeds of pigeopeato attain physiological maturity at 30 days after initiation of flowering (DAI) as indicated by the highest seed weight, germination and seedling dry weight over control.

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