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Effect of GA_3 on marigold seed production in Gangetic Alluvial Zone

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ABSTRACT

Marigold (Tagetes sp.) is native to the New World and blessed flowers of the Aztecs, journeyed across the Atlantic Ocean twice to travel 3,000 miles north of their centre of origin. It is one of the commercially exploited flower crops of both tropics and subtropics. The field trial was conducted in new alluvial zone at Horticulture Research station, Mondouri, B.C.K.V., Mohanpur, Nadia, West Bengal during Rabi season of 2017-18 to 2018-19. The field experiment was carried out to assess the potential of growth, flowering and seed production of twelve marigold genotypes through the influence of GA_3 as foliar application was made over two consecutive years. Field performance of twelve genotypes of marigold was observed for different parameters like plant height (cm), branches plant^{-1}, days to first 50% flowering, number of flowers plant^{-1}, flower diameter(cm), number of seeds flower^{-1}, test weight (g) and seed yield plant^{-1}(g). As largest size of flowers and highest seed yield plant^{-1} only were recorded after PusaNarangi (V_9), it could be considered as the best performer genotype considering its higher number of flowers plant^{-1} and number of seeds flower^{-1}.Concomitant consideration of seed yield and its important attributes may indicate to recommend foliar application of 100 ppm GA_3 for enhancement in seed yield in all the genotypes, especially for Pusa Narangi (V_9), Yellow Single (V_{10}), Bidhan Basanti (V_2) and Bidhan Marigold-1 (V_1).

Keywords: Marigold, GA_3, seed yield.

Marigold is divine flowers of the Aztecs, expeditioned across the Atlantic Ocean twice to travel 3,000 miles north of their centre of origin and it is native to the New World. In India, Marigold was introduced by Portuguese during 16th century (Gawle *et al*., 2012). Marigold ranks first among the commercial loose flowers in India followed by chrysanthemum, jasmine, tuberose, crossandra and barleria (Gajanana and Sudha, 2006, Chakrabortyet *al.*, 2019). The production of marigold in India is 511.31 thousand MT under an area of 55.89 thousand hectare (Saxena and Gandhi, 2015). West Bengal has become one of the leading states in marigold commercial cultivation across the country. Especially, African Marigold is grown at a large scale mainly in the districts of Midnapore, Howrah, Hooghly, 24 Parganas and Nadia.

In Indian loose flower trade, it has a great economic potential. Farmers are generally interested on flower production due to its free flowering nature, short duration of cropping, different colour and good keeping quality but not on seed production (Kumari *et al.*, 2016). Thus, they have to buy the seeds from the market at high price (Kumari *et al.*, 2017). Though the plant produces large size quality flowers that fetches high price in the market, but long and weak stem, stature, delayed flowering are some of the integrated problems of this crop (Mahato *et al*., 2017). These may result in poor flower and seed yield. Application of plant growth regulators is presently gaining its potential in various crop cultivation practices.Tyagi and Singh (2006),Mayoli *et al*.(2009),Wagh *et al*. (2012) and Rani and Singh (2013) suggested that GA_3 promotes the sprouting, stem elongation, increased leaf production, reduces flowering time, increases flower number and size, *etc*. in different floricultural crops.Gibberellic acid becomes effective to improve vegetative growth and flower production in marigold (Kumar *et al*., 2010 b.).

Keeping all the facts mentioned above in mind present research work was conducted in new alluvial zone at Horticulture Research station, Mondouri, Bidhan Chandra KrishiViswavidyalaya, Mohanpur, Nadia, West Bengal, India during *rabi* season of 2017-18 and 2018-19 to optimize the proper concentration of gibberellic acid for exogenous application as foliar spray and to assess the effect of GA_3 on growth, development and flowering of twelve genotypes of marigold with special reference to quality seed production.

MATERIALS AND METHODS

The field trial was carried out in new alluvial zone at Horticulture Research station, Mondouri, Bidhan Chandra KrishiViswavidyalaya, Mohanpur, Nadia, West Bengal, India during *rabi* season of 2017-18 and 2018-

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19. Soil pH of experimental site was6.6-6.7, containing organic carbon 0.74%, sandy loam in texture, total available Nitrogen 0.07%, Phosphorus 28.50 kg ha^{-1} and potassium 78 kg ha^{-1}. Seeds of twelve marigold genotypes were grown in the experimental plots. Standard agronomic practices and intercultural operations were followed for raising seedlings in individual plots. Twenty days old healthy and uniformly grown seedlings were used for transplanting with a spacing of 25 x 25 cm at the rate of one seedling $hill^{-1}$ with three replications following Randomised Block Design. Spacing was 25 cm between the rows and 50 cm between the two plots. Each plot was 2m in length and 2 m in breadth. Fertilizer was applied in both the years as per standard recommendation. Foliar application of both the doses of Gibberellic acid (*i.e.* 50 ppm and 100 ppm) was made on plants at three weeks after transplanting and the non-sprayed plants were treated as control. Five plants were randomly tagged at the early crop growth stage and observations on different traits were recorded by a specific method, like plant height (cm) at 50% flowering, number of branches $plant^{-1}$, days to first and 50% flowering, number of flowers $plant^{-1}$, number of seeds $flower^{-1}$, test weight (g) and seed yield $plant^{-1}$ (g).

RESULTS AND DISCUSSION

Influence of GA_3 on performance of different marigold genotypes

Assessment of influence of GA_3 as foliar application was made over two consecutive years for different agronomic characters excepting test weight for which it was made during 2018-19 along with the quality parameters (physiological) of the produced seeds. Significant variation among the performance of the genotypes, influence of doses of GA_3 as well as its interaction effects noted for all agronomic characters excepting days to both first and 50% flowering as well as average flower diameter for which non-significant interaction effect was noticed. Non-significant variation in number of branches $plant^{-1}$ was noticed in first year only.

Plant height (cm)

During 2017-18, significantly tallest plants were observed for V_9 (*i.e.*, Pusa Narangi) followed by V_{10} (Yellow Single), when average was made over the treatments, while most dwarf plants were recognized for Arka Bangara-1 (28.21 cm) preceded by Arka Bangara-2 and BM-3, though non-significant difference could be noticed among genotypes (Table 1). Average influence of 100 ppm GA_3 was significantly superior to that of 50 ppm GA_3 over control for exhibition of plant height at 50% flowering stage. While considering the interaction between genotypes and treatments, significantly maximum plant height was recorded for V_9 after application of 100 ppm GA_3 followed by V_{10} after application with same dose of GA_3. Similar to the average influence of GA_3 doses, high GA_3 dose exerted greater influence than that of lower dose for almost all the genotypes excepting V_1, V_7 and V_{12}, for which non-significant difference between influence of both the doses of GA_3 was recognized. At the same time non-significant enhancement in plant height over control could be noticed after application of 50 ppm GA_3 when applied for V_3, V_4, V_7, V_{10} and V_{11}.

Average plant height at 50% flowering of V_9 (Pusa Narangi) was also found to be maximum (64.79 cm) followed by that of V_{10} (Yellow Single) during 2018-19 as was observed in second year; dissimilar to first year, V_3 (BM-3) produced dwarf plants of average 28.35 cm height preceded by those of V_7, though non-significant difference could be noticed between the average performance of V_3 and V_7 in 2018-19. Significantly enhanced average plant height over control (without application of GA_3) could also be recorded after application of GA_3 and plant height increased with the increased concentration of GA_3 (Table 1). The trend in enhancement in plant height of individual genotypes also followed the similar pattern as was recorded for average influence of GA_3 concentration with some exceptions: 50 ppm GA_3 could not be able to enhance plant height over control for V_3, V_4 and V_7; and non-significant difference between influence of 50 and 100 ppm GA_3 could be noticed for V_7. Plant height was recorded to be as maximum as 85.64 cm for V_9 after application of 100 ppm GA_3 followed by that of G_{10} after application of same highest dose of GA_3.

Number of branches $plant^{-1}$

It could be revealed through table 2 that the genotypes varied significantly amongst it selves for production of number of branches $plant^{-1}$ in both the years: maximum number of branches was recorded for V_9 followed by V_7, V_8, V_6 and V_{10} in both the years, though $V_6$and V_{10} produced same number of branches (8.33) $plant^{-1}$ in second year. When average was made over the genotypes, T_3 *i.e.*, 100 ppm GA_3 was noticed to exert influence for production of maximum number of branches $plant^{-1}$ followed by that of 50 ppm GA_3 and both the concentrations was able to enhance this parameter over control. Change in magnitude of individual genotypes, influence of GA_3 as well as its interaction effects over the years may be due to varied performance of the genotypes towards changed climatic condition prevailed during the cropping season of the

respective years. Though non-significant enhancement in magnitude over control could be noticed irrespective of the genotypes in first year and it was enhanced with the enhancement in GA_3 concentration. Similar trend was observed in second year for all the genotypes, but the changes were noticed to occur in significant manner with a few exceptions; non-significant influence of 50 ppm GA_3 over control for production of branches plant^{-1} was noticed for V_1, V_3, V_6, V_{11} and V_{12}, while non-significant variation in influence of both 50 and 100 ppm GA_3 for expression of this character could be noticed for V_8 only.

Days to first flowering

Among the genotypes over treatments, longest duration to first flowering was noted for V_{12} (64.67 days) *i.e.*, Red Fresh Inka during 2017-18 followed by V_6 (BM-6), while it was minimum for V_4 *i.e.*, BM-4 preceded by V_2, though both V_4 and V_2 performed at per with each other (Table 1). Over the genotypes, maximum duration to flower first was observed for T_1 (58.42 days) *i.e.*, in control condition and it was minimum for T_3 (54.53 days) *i.e.*, 100 ppm GA_3. It is to be noted that first flowering was accelerated with the application of GA_3 and it is directly related with the enhancement in GA_3 dose *i.e.*, consistent reduction in days to first flowering took place with the enhancement in GA_3 concentration. Though the interaction effect *i.e.*, influence of GA_3 concentration on individual genotypes was non-significant, all the genotypes responded in similar manner as was noted for average influence of GA_3 concentrations. However, maximum days to first flowering was recorded for Red Fresh Inka without application of GA_3.

The trend in average performance of the genotypes and influence of GA_3 concentration in 2018-19 was similar to that noticed in 2017-18 with a slight change in magnitudes only, which may be due to the variation in climatic conditions during experimentation over the years (Table 1). Response of individual genotypes towards application of varying GA_3 concentration was also found to be non-significant in 2018-19; still maximum number of days (68.00) taken to first flower was also recorded for Red Fresh Inka with GA_3 application and consistent reduction in days to first flower was noticed for all the genotypes with enhancement in GA_3 concentration.

Days to 50% flowering

The genotypes varied significantly for days required to 50% flowering in both the years, application of varying doses of GA_3 significantly affected the days to 50% flowering, but non-significant difference in change in magnitudes for this parameter of individual genotypes after foliar application of GA_3 could be observed (Table 2), similar to that of expression for days required to first flowering. Maximum number of days to 50% flowering was recorded in control and it was consistently reduced with the enhancement in GA_3 concentration in both the years. V_{12} consistently required maximum days to 50% flowering followed by that of V_6, V_3 and V_9, while it was minimum for V_4 preceded by V_2, V_{11} and V_{10} in both the years. Though non-significant change in response of individual genotypes was noticed, V_{12} took the maximum number of days to 50% flowering without application of GA_3 irrespective of the years of experimentation followed by that of V_6, V_9 and V_3.

Flower diameter (cm)

Consideration of influence of GA_3 application average over genotypes, indicated that average flower diameter was enhanced over control after application of either concentration of GA_3 irrespective of the years of experimentation and greater influence of 100 ppm GA_3 could be noticed in comparison to that of 50 ppm. If ranking is made amongst the genotypes with regard to its average flower diameter, it could be noticed as V_9 Ã $V_5 = V_2 = V_{12}$ Ã $V_1 = V_4 = V_3$ Ã $V_{11} = V_{10} = V_7 = V_8$ e" V_6 in 2017-18 and V_9 Ã $V_5 = V_2$ Ã V_{12} Ã $V_1 = V_3$ Ã $V_{11} = V_4$ e" V_8 e" $V_{10} = V_7 = V_6$ in 2018-19 (Table 2). Highest magnitude in floral diameter was noticed in V_9 after application of 100 ppm GA_3 in both the years and that magnitude was found to be increased with enhancement in GA_3 concentration over the years, but in non-significant manner. The change in magnitude over the years of experimentation may be due to the expression of reaction to changing climatic condition during the crop growth period.

Number of flowers plant^{-1}

Significant enhancement in number of flowers could be noticed after application of GA_3 in either concentration in both the years, when average was made over the genotypes. Average potentiality of individual genotypes with regard to production of flower numbers was found to be significantly varied amongst it selves. Significantly highest average number of flowers was noted for 100 ppm GA_3 followed by 50 ppm GA_3 and unsprayed control in first year. When average was made over the treatments, the number of flowers was as maximum as 122.11 for V_{12} followed by V_1, V_3 and V_2 in first year, though V_1, V_3 and V_2 performed in statistically similar manner for expression of the character and the minimum number of flowers was produced by V_8 and V_{11} (Table 3).

The trend in enhancement in flower number after application of GA_3 in second year was found to be similar to that observed in first year. The trend in performance

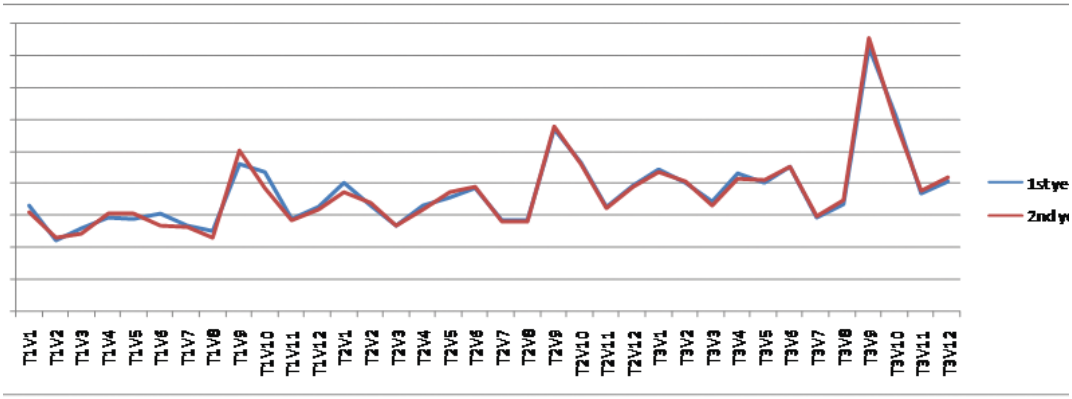

Fig. 1: Plant height (cm)

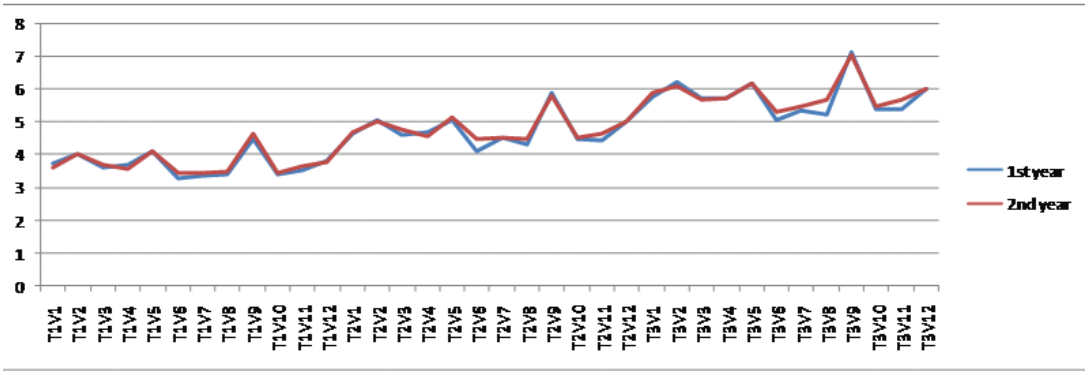

Fig. 2: Flower diameter (cm)

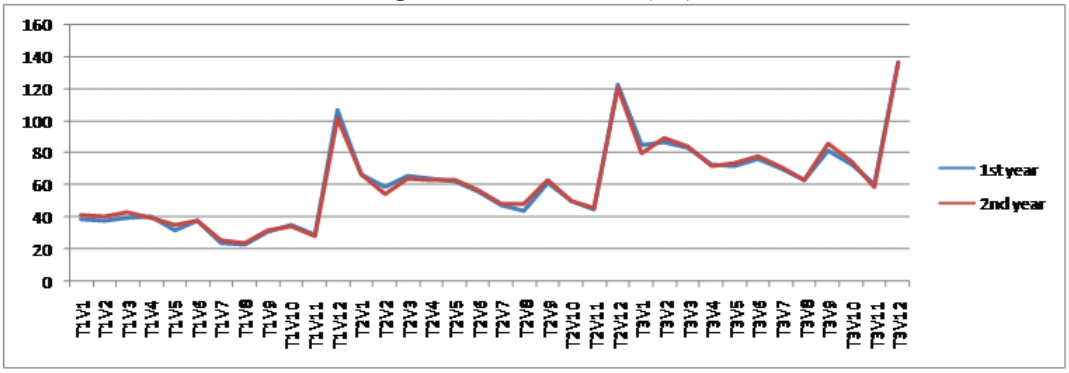

Fig. 3: Number of flowers plant^{-1}

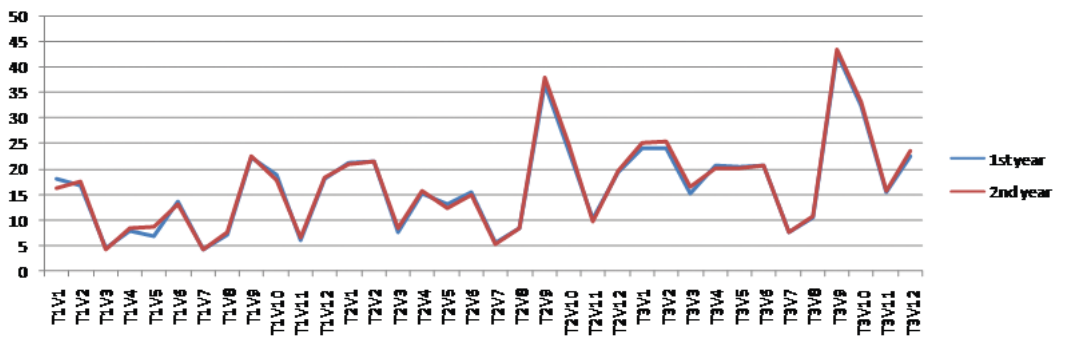

Fig. 4: Seed yield plant^{-1} (g)

Experimental field

Bidhan Marigold-1 **Bidhan Basanti** **BM - 3** **BM - 4**

BM - 5 **BM - 6** **Arka Bangara-1** **Arka Bangara-2**

Pusa Narangi **Yellow single** **Orange single** **Red Fresh Inka**

Seeds of different marigold genotypes

of individual genotypes for production of number of flowers in second year was as also same as that recorded in first year, particularly with regard to highest and lowest number of flower producers (Table 3). All the genotypes responded in similar fashion for number of flower production after application of GA_3 in different concentrations over the years, as was noticed for average influence of GA_3 doses. It was of significantly highest value for V_{12} after application of 100 ppm GA_3 in both the years followed by that V_2, V_1 and V_3 in first year and V_2, V_3 and V_1 in second year. Lowest number of flowers was found to be produced by V_{11} after unsprayed control in both the years.

Number of seeds flower^{-1}

Significant variation among the genotypes for its potentiality of seed production could be noticed over the years of experimentation. Concentrations of GA_3 also exerted its significant influence for enhancement in number of seeds flower^{-1}. Individual genotypes also responded in significant manner for expression of this character towards application of GA_3 and its concentration. Highest number of seeds flower^{-1} could be harvested for V_4 over the years, when average was made over treatments, and it was followed by V_9 and V_{10} irrespective of the years, while average number of flowers was recorded to be lowest for V_{12} preceded by that of V_{11}. Significant enhancement in number of seeds flower^{-1} could be made possible through foliar application of either 50 or 100 ppm GA_3 irrespective of the year and number of seeds produced was enhanced with the enhancement in GA_3 concentration (Table 3). Overall scenario indicated that number of seeds of individual genotypes was also enhanced with the enhancement in GA_3 concentration in both the years; but critical analysis on interaction effects indicated that the trend and rate of enhancement varied with the genotypes indicating that the response was typically genotype specific. It is to be noted that maximum number of flowers were produced by V_4 and V_9 in unsprayed control situation, but it was of maximum value for V_1, V_4 and V_{10} after application of 100 ppm GA_3, indicating that rate of enhancement in number of seeds individual flower^{-1} was greater in the genotypes V_1 and V_{10} in comparison to that of V_9, but V_4 maintain its position for enhanced number of seeds in very unique manner.

Test weight (g)

Average test weight of seeds of different genotypes was found to be significantly varied with the highest magnitude of 2.41 g in both the years for V_{12} followed by V_9, V_{10}, V_{11} and V_1, though non-significant difference in test weight could be noticed between V_9 and V_{10}; while non-significant difference could be noticed among V_3, V_5 and V_7, recording lowest test weight irrespective of the year of experimentation (Table 4). Significant influence of GA_3 could be observed for enhancement in test weight, on an average and significant enhancement in this parameter could be noticed with the enhancement in GA_3 concentration. Though non-significant, the highest magnitude in test weight could be noticed for V_{12} after application of 100 ppm GA_3 in both the years and influence of GA_3 on individual genotypes for this parameter followed the similar pattern, as could be noticed for average influence of GA_3 application, but strictly in non-significant manner.

Seed yield plant^{-1} (g)

Average potentiality of individual genotypes varied significantly for its seed production plant^{-1}, GA_3 along with its two different concentrations influenced significantly or enhancement in seed production over the years and the genotypes also responded in significant manner towards GA_3 application for expression of this parameter. Influence of 100 ppm GA_3 was found to be significant and greater in comparison to that of 50 ppm over control for seed yield plant^{-1} in both the years, when average was made over the genotypes; the rate of enhancement was almost similar over the years. Consideration of average performance of the genotypes, average over the treatments, indicated that V_9 could be identified as the highest producer in both the years and if ranking is made amongst the genotypes for this parameter it could be represented as V_9 Ã V_{10} Ã V_1 = V_2 = V_{12} Ã V_6 Ã V_4 = V_5 Ã V_{11} = V_3 Ã V_8 Ã V_7 in both the years, slight change in genotypic performance may be due to variation in climatic conditions prevailed during the crop growth period of experimentation (Tables 4). Critical consideration of the interaction effects may lead to identify V_9 as the highest seed producer in both the years when applied with 100 ppm $GA_3$and the reflection of trend in general influence of GA_3 concentration could also be noticed for individual genotypes over the years *i.e.*, seed yield plant^{-1} of individual genotypes enhanced with the enhancement in GA_3 concentration. Unique genotypic response could be regarded through the rate of enhancement after application of GA_3 over unsprayed control.

As largest size of flowers and highest seed yield plant^{-1} only were recorded after Pusa Narangi, it could be considered as the best performer genotype considering its higher number of flowers plant^{-1} and number of seeds flower^{-1}. Though overall influence of GA_3 has been found to enhance seed yield plant^{-1}and all the important attributes; 100 ppm GA_3 could be utilized in a better way for greater enhancement in all those important parameters. Concomitant consideration of seed yield and its important attributes may indicate to recommend foliar application of 100 ppm GA_3 for enhancement in seed yield in all the genotypes, especially for Pusa Narangi, Yellow Single, Bidhan Basanti and Bidhan Marigold-1. Similar to the seed yield and its attributes, plant growth and development have been noticed to be positively influenced by GA_3 concentrations with a higher side after 100 ppm, may lead to recommend foliar application of 100 ppm GA_3 for commercial cultivation of this crop irrespective of the genotypes.

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REFERENCES

Chakraborty, A., Bordolui, S.K., Mahato, M. K., Sadhukhan, R. and Sri Veda, D.J.M.S.N.K. (2019).Variation in seed production potential of China aster genotypes in the New Alluvial Zone of West Bengal. *J. Crop and Weed*,**15(1)**: 201-04.

Gajanana, T. M. and Sudha, M., 2006.Production and Marketing Research on Traditional Flowers. *Adv. Ornamental Hort.***6**: 19-23.

Gawle, S. K., Chaturvedi, M. K. and Yadaw, K. N.(2012).Adoption pattern of improved marigold production technologies by the farmers in Bilashpur district of Chhattisgarh. *Ag. Update.***7**(3/4): 323-29.

Kumar, R., Ram, M. and Gaur, G. S. 2010. Effect of GA_3 and ethrel on growth and flowering of African marigold cv. PusaNarangiGainda.*Indian J. Hort.*.**67**(4): 362-66.

Kumari, P., Bordolui, S.K. and Sadhukhan, R. 2016. Seed and seedling quality evaluation of some winter flower in New Alluvial Zone. *J. Crop and Weed*, **12**(3): 23-26.

Kumari, P., Bordolui, S. K. and Sadhukhan, R. 2017. Seed quality deterioration of some winter flowers during storage.*J. Crop and Weed.* **13**(1): 164-69.

Mahato, M. K., Bordolui, S.K., Sadhukhan, R. and Moharana, R .L. 2017. Evaluation of seed production potential of China Aster in new alluvial zone. *Bioscan,* **12**(3): 1649-52.

Mayoli, R. N., Isutsa, D. K. and Tunya, G. O. 2009.Growth of ranunculuscutflower under tropical high altitude conditions. 1: Effect of GA_3 and shade. *African J. Hort. Sci.*, N.(2013). Impact of gibberellic acid pretreatment on growth and flowering of tuberose (*Polianthestuberosa* L.) cv. Prajwal. *J. Trop. Pl. Physiol.***5**: 33-41.

Saxena, M. and Gandhi, C. P.(2015).National Horticulture Board. *Indian Horticulture Database.*pp. 286.

Tyagi, A. K. and Singh. 2006. Effect of gibberellic acid and vermicompost on vegetative growth and flowering in African marigold (*Tageteserecta* Linn.). *J. Ornamental Hort..***9**(2): 150-51.

Wagh, V. K., Chawla, S. L., Gaikwad, A. R. and Parolekar, S. S. 2012. Effect of bulb size and GA_3 on vegetative and floral characters of tuberose (*Polianthestuberosa* L.) cvs.Prajwal and Calcutta Single. *Progressive Hort..***44**(1): 27-31.