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Original Research Article

Effect of Gibberellic Acid, Salicylic Acid, Cow Urine and Vermiwash on Corm Production of Gladiolus cv. Candyman

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A B S T R A C T

A study was carried out to find out the effect of GA_3, SA, cow urine and vermiwash on corm production of gladiolus cv.Candyman at Horticultural Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during year 2011-12 and 2012-13. Treatments including seven levels of plant growth regulators *viz.*, No PGR,GA_3 and SA each @ 100,200 300 ppm, two levels of cow urine and vermiwash each @ 5% and 10% and a control (water spray treatment). Significantly highest plant emergence (96.67 %), tallest plant (88.45 cm), longest (56.70 cm) with more number (7.91) and width (3.80 cm) of leaf, earliest 50 % spike initiation (67.32 days), longest spike (71.60 cm) and rachis (54.98 cm), higher number of cormels plant^{-1} (34.29) and number of corm hectare^{-1} (159325.4) were recorded under GA_3 @ 200 ppm. However, corms treated with 300 ppm GA_3 produced maximum diameter (6.48 cm) with weight of corms (66.26 gm) and cormels plant^{-1} (19.17 gms), whereas minimum values was recorded in control. No significant effect was found due to levels of cow urine and vermiwash on vegetative, flowering and corm parameters studied in the present investigation. However, both the levels of cow urine and vermiwash (5% and 10%) resulted in significantly higher emergence of plants, increase plant height, more number of leaves plant^{-1}, longer and wider leaf, earlier emergence of 50% spikes, longer spikes and rachis, bigger and heavy corms plant^{-1}, more number and weight of cormels plant^{-1} and more number of corms hactare^{-1}as compared to control.

Keywords

Plant growth regulators (PGR), Vermiwash, Cow urine, Gibberellic acid (GA_3), Salicylic acid (SA), Corms, Cormels

Introduction

The modern gladiolus hybrids are botanically known as *Gladiolus grandiflorus* belonging to family Iridaceae. Gladiolus is popularly known as "queen of bulbous flower" with its magnificent inflorescence. The flowers, varying in colour with attractive shades mainly grown in herbaceous border, bed, pot and also for cut flowers have good shelf-life. Floriculture is still in infant stage in Chhattisgarh.

Gladiolus is the most important cut flower crop in the country and rank third in Chhattisgarh in case of area. In Chhattisgarh, the area under the floriculture was 10130 hectare with production of 457300 MT Gladiolus is cultivated in 1870 hectare with the production of 5770 metric tons (Anonymous, 2015). Till now, the farmers of the state largely depends on other state for planting materials. However, with

improved agronomic techniques and better management, there is enormous scope in Chhattisgarh, for cut flower spikes as well as for corm production (planting materials).

Large and medium sized corms are used for production of cut spikes, where small sized corms or cormels are generally used for the production of flower grade corms for the subsequent planting seasons as cormels are incapable of producing spikes. Plant growth regulators play an important role in breaking dormancy and promote more number of quality corm productions in gladiolus (Bhattacharjee, 1983). Among plant growth regulators, use of exogenous gibberellins in breaking dormancy is not well understood but it has been postulated that gibberellins regulate mobilization of food reserves (Mares *et al.*, 1981) and interact with inhibitors such as abscissic acid (Hemberg, 1965). Salicylic acid belongs to a group of phenolic compounds that widely exists in plants and now a day is considered as a hormone-like substance. This acid also plays an important role in plant growth and development (Mazaheri and Manochehri, 2007).

The cow urine, besides providing nutrients like potassium and other beneficial substances to the plants, is a cheap input and easy to acquire by the rural producer. It is known to have beneficial effect on germination, growth and yield components (Josef and Nair, 1989; Chawla, 1986). Vermiwash also plays an important role in the plant growth and development; contribute to initiation of rooting, root growth, plant development, promotion of growth rate and improvement in crop production by increasing nutrient content which are readily available for the plants, resulting in good crop yield (Wareing, 1982; Sivasubramanian and Ganeshkumar, 2004). Production of quality planting material has great potential in floriculture which directly affects quality and quantity of flower production. Hence, an attempt was made to ascertain the effect of vermiwash and cow urine along with synthetic growth regulators (GA_3 and SA) on corm production of gladiolus.

Materials and Methods

The experiment was conducted during *rabi* season of 2011-12 and 2012-13 in the Horticultural Farm, Indira Gandhi Krishi Viswavidyalaya, Raipur (Chhattisgarh) with the objective to investigate the effect of growth substances (plant growth regulators *i.e.* GA_3 and SA, cow urine and vermiwash) on gladiolus cultivar Candyman. Healthy corms of uniform size (3.5-4.5 cm diameter) were planted at a spacing of 30 cm x 20 cm in beds of 1.4 m x 1.2 m dimension. The experiments were laid out in Randomized Block Design (RBD) with factoral arrangement in combination of twenty eight treatments and a single control treatment with three replications. The treatments comprised, seven levels of plant growth regulators viz., P_0 (No PGR), P_1 (GA_3 @100 ppm), P_2 (GA_3 @ 200 ppm), P_3 (GA_3 @ 300 ppm), P_4 (SA @100 ppm), P_5 (GA_3 @ 200 ppm) and P_6 (SA @ 300 ppm), two levels of cow urine i.e. 5% (C_1) and 10% (C_2), and two levels of vermiwash *i.e.* 5% (V_1) and 10% (V_2) and a control (water spray treatment) were applied as pre-planting soaking of corms for 24 hours followed by two foliar sprays each at 30 and 60 days after planting of corm. Data on emergence of plants was recorded at 30 days after planting while plant height, number, width and length of leaf were recorded at 60 days after planting. Data on flower parameters were recorded at different stages of plants *i.e.* at 50 % emergence of spikes, spike and rachis length at full bloom stages and corms parameters were recorded at harvesting of

corms. Statistical analysis was carried out according to Still and Torrie (1980)

Results and Discussion

Effect of plant growth regulators on vegetative, floral and corm parameters

The results presented in Table 1 and 2 clearly indicated that the GA_3 and SA each at 100,200 and 300 ppm have significant improvement on emergence of plants, plant height, number and width of leaf, diameter and weight of corm, weight and number of cormels plant^{-1} as compared to control (water spray) treatment. However, no significant difference was found between treatments "No PGR' (treatment consist the average effect of cow urine and vermiwash each @ 5% and 10% alone without PGR) and control (water spray) treatment for above mentioned traits. Significant longer leaf, earlier 50% spike emergence and increased number of corms hectare^{-1} was also recorded with all the levels of PGR over control except treatment No PGR and SA @ 300 ppm. Spike and rachis length was significantly increased by all the levels of plant growth regulators as compared to control treatment.

Results depicted in Table 1 further revealed that among the different levels of plant growth regulators, GA_3 @ 200 ppm proved to be the superior treatment in resulting significantly highest plant emergence (96.67 %), tallest plant (88.45 cm), longest (56.70 cm) with more number (7.91) and width (3.80 cm) of leaf followed by its lower concentration *i.e.* 100 ppm. The higher concentration of same treatment *i.e.* 300 ppm was also noted comparable to its 100 and 200 ppm concentration for these attributes except for plant height. The superior performance of gibberellic acid in improving emergence of plants could be due to alteration of hormonal balance in favour of promoters due to exogenous application of GA_3. The similar findings have been obtained by Groot and Karssen (1987). The increased plant height, number, length and width of leaf due to gibberellic acid could probably be due to its growth promotional effect in stimulating and accelerating cell division, increased cell elongation and enlargement or both (Hartmann *et al.,* 1990; Mukhopadhyay and Bankar, 1986). Our findings are in conformity with results of Sharma *et al.,* (2006) and Umrao *et al.,* (2008) in gladiolus (Table 1).

Earliest 50% spike initiation (67.32 days), longest spike (71.60 cm) and rachis length (54.98 cm) were recorded in 200 ppm of GA_3 followed by its lower concentration *i.e.*100 ppm. Application of GA_3, at all the levels, proved most effective in improving all the floral attributes as compared to salicylic acid. All these floral traits were improved significantly with increased levels of GA_3 up to its intermediate level *i.e.* 200 ppm and further increase in concentration from 200 to 300 ppm, no further improvement in these floral traits were observed which might referred the adverse effect on growth parameters of crop and resulted into inferior floral attributes. Similar results are also reported by Rana *et al.,* (2005) in gladiolus.

The analyzed data presented in Table 2 indicated that the corm and cormels production was significantly affected by gibberellic acid. In the present study, although higher concentrations of GA_3 @ 300 ppm exhibited superior performance for most of corm parameters but the similar treatment was found to be statistically *at par* with its lower concentration *i.e.* 200 ppm. Corms treated with 300 ppm GA_3 produced largest diameter of corms (6.48 cm) with maximum weight of corms (66.26 gm) and cormels plant^{-1} (19.17 gm). However, significantly higher number of cormels

plant^{-1} (34.29) and number of corm ha^{-1} (159325.4) were recorded under GA_3 @ 200 ppm and found *at par* with 300 ppm while minimum observation for all these parameters were recorded under control (water spray). Kumar *et al.,* (2009) reported that the ability of GA_3 to increase the number of leaves which increased the photosynthetic assimilates and these assimilates are transported to the resulting corm and cormels, thereby increasing their size and weight. Our findings are in close conformity with reported by Bhalla and Kumar (2008) and Dogra *et al.,* (2012) in gladiolus. The increase com parameters due to GA_3 over control were also reported by Baskaran *et al.,* (2009), Kumar and Singh (2005) in gladiolus.

Effect of cow urine on vegetative, floral and corm parameters

No significant effect was found due to levels of cow urine on vegetative, flowering and corm parameters studied in the present investigation. However, both the levels of cow urine (5% and 10%) resulted in significantly higher emergence of plants, increase plant height, more number of leaves plant^{-1}, longer and wider leaf, earlier emergence of 50 % spikes, longer spikes and rachis length, bigger and heavy corms plant^{-1}, more number and weight of cormels plant^{-1} and more number of corms hactare^{-1}as compared to control (water spray).

Cow urine is known for presence of growth promoting auxin like IAA (Zhang, 2000) and rich in nutrients (Ramachandrudu and Thangam, 2007). According to Phrimantoro (1995), cow urine contains many of those elements that are needed by plants, such as N, P, K, Ca, Na and others and its existence cannot be replaced by other nutrients for plant growth and development. In the present study, application of nutrient and growth substance rich cow urine found helpful in enhancing the carbohydrate accumulation and photosynthesis in plants might be the possible reason in achieving higher emergence of plants and improved vegetative, flowering and corm parameters.

The results in the present study are in contrary with findings of Ramachandrudu and Thangam (2007) who observed reduction in plant height and number of leaf due to application of 10% cow urine than control in gladiolus variety 'White Prosperity'. But, our findings are in conformity of them in respect to increased length and width of leaves, diameter and weight of corm with cow urine 10%. Increased leaf length has also been reported by Ilango *et al.,* (1999) in *Albizia lebbeek.*

Effect of vermiwash on vegetative, floral and corm parameters

Vermiwash at both the levels *i.e.* 5% and 10% significantly improved all the vegetative characters as compared to control (water spray) in the present investigation during both the years of study. However, both the levels of vermiwash did not differ significantly for all the vegetative, flowering and corm parameters. Vermiwash promote increased microbial activity and enzyme production (Ansari; 2008) and it also contains N, P, K, Ca and hormones such as auxin, cytokinine, some other secretion of many useful microbes like heterotrophic bacteria and fungi (Rai and Bansiwal, 2008; Lee, 1988 and Shield, 1982) which might have turned into significantly higher emergence of plants, increase plant height, more number of leaves plant^{-1}, longer and wider leaf, earlier emergence of 50 % spikes, longer spikes and rachis length, bigger and heavy corms plant^{-1}, more number and weight of cormels plant^{-1} and more number of corms hactare^{-1}as compared to control (water spray) of gladiolus plants in the present study.

Table.1 Effect of plant growth regulators, cow urine and vermiwash on vegetative and floral parameters

Treatments	Plant Emergence at 30 DAP (%)	Plant Height (cm)	Number of Leaves	Leaf Length (cm)	Width of Leaf (cm)	Days to 50% Spike initiation	Spike Length (cm)	Rachis Length (cm)
PGR								
P_0 (No PGR)**	83.45	76.94	6.88	50.82	3.37	74.23	65.80	51.25
P_1 (GA_3 @ 100 ppm)	95.60	87.28	7.84	55.82	3.72	67.46	70.95	54.51
P_2 (GA_3 @ 200 ppm)	96.67	88.45	7.91	56.70	3.80	67.32	71.60	54.98
P_3 (GA_3 @ 300 ppm)	93.45	85.19	7.80	55.31	3.68	69.92	69.11	53.14
P_4 (SA @ 100 ppm)	89.40	81.60	7.32	52.15	3.51	73.20	66.88	51.66
P_5 (SA @ 200 ppm)	91.05	82.16	7.33	52.09	3.53	71.42	65.88	51.42
P_6 (SA @ 300 ppm)	88.69	82.40	7.12	51.11	3.43	73.93	64.56	50.04
SEm±	0.45	0.44	0.05	0.64	0.05	0.17	0.24	0.18
$CD_{0.05\%}$	1.29	1.24	0.12	1.82	0.13	0.47	0.69	0.51
Cow urine								
C_1 (Cow urine @ 5%)	91.16	83.26	7.45	53.07	3.57	70.98	67.84	52.45
C_2 (Cow urine @ 10%)	91.22	83.60	7.46	53.79	3.58	71.16	67.81	52.41
SEm±	0.24	0.23	0.02	0.34	0.02	0.09	0.13	0.10
$CD_{0.05\%}$	NS	NS	NS	NS	NS	NS	NS	NS
Vermiwash								
V_1 (Vermiwash @ 5%)	91.39	83.56	7.46	53.42	3.58	70.94	67.97	52.41
V_2 (Vermiwash @ 10%)	90.98	83.30	7.45	53.44	3.57	71.19	67.68	52.45
SEm±	0.24	0.23	0.02	0.34	0.02	0.09	0.13	0.10
$CD_{0.05\%}$	NS	NS	NS	NS	NS	NS	NS	NS
Control	81.68	75.63	6.72	48.68	3.22	74.55	62.80	48.05
SEm±	0.65	0.63	0.07	0.92	0.07	0.24	0.35	0.26
$CD_{0.05\%}$	1.85	1.78	0.18	2.62	0.19	0.68	0.98	0.74

**Treatment consist the average effect of cow urine and vermiwash each @ 5% and 10% alone without PGR

Table.2 Effect of plant growth regulators, cow urine and vermiwash on corm parameters

Treatments	Diameter of Corm (cm)	Weight of Corm plant^{-1} (gm)	Weight of Cormels plant $^{-1}$ (gm)	Number of Cormels plant^{-1}	Number of Corms ha^{-1}
Plant Growth Regulator					
P_0 (No PGR)**	5.24	45.38	14.40	27.31	139881.0
P_1 (GA_3 @ 100 ppm)	6.15	55.14	18.04	30.63	157539.7
P_2 (GA_3 @ 200 ppm)	6.42	64.03	18.13	34.29	159325.4
P_3 (GA_3 @ 300 ppm)	6.48	66.26	19.17	34.15	152381.0
P_4 (SA @ 100 ppm)	5.90	54.34	15.24	30.28	145634.9
P_5 (SA @ 200 ppm)	6.07	62.99	15.62	29.11	150000.0
P_6 (SA @ 300 ppm)	5.85	51.42	15.75	28.90	141666.7
SEm±	0.05	0.85	0.38	0.68	886.2
CD $_{0.05\%}$	0.13	2.41	1.08	1.93	2510.7
Cow urine					
C_1 (Cow urine @ 5%)	5.98	56.72	16.77	30.37	149433.1
C_2 (Cow urine @ 10%)	6.05	57.44	16.48	30.96	149546.5
SEm±	0.03	0.455	0.20	0.36	473.7
CD $_{0.05\%}$	NS	NS	NS	NS	NS
Vermiwash					
V_1 (Vermiwash @ 5%)	6.00	56.82	16.41	30.59	149829.9
V_2 (Vermiwash @ 10%)	6.03	57.34	16.83	30.75	149149.7
SEm±	0.03	0.455	0.20	0.36	473.7
CD $_{0.05\%}$	NS	NS	NS	NS	NS
Control	5.06	42.79	12.85	24.63	138095.2
SEm±	0.07	1.70	0.55	0.98	1275.5
CD $_{0.05\%}$	0.19	3.47	1.56	2.77	3613.5

**Treatment consist the average effect of cow urine and vermiwash each @ 5% and 10% alone without PGR

Table.3 Interaction effect of plant growth regulators and cow urine on number of corms ha^{-1}

Treatments	Emergence of plants at 30 DAP (%)	Number of Corms ha^{-1}
P_0 x C_1 (PGR 00ppm X Cow urine @ 5%)	83.81	138888.89
P_0 x C_2 (PGR 00ppm X Cow urine @ 10%)	83.10	140873.02
P_1 x C_1 (Gibberellic Acid 100ppm X Cow urine @ 5%)	96.19	157142.86
P_1 x C_2 (Gibberellic Acid 100ppmXCow urine@10%)	95.00	157936.51
P_2 x C_1 (Gibberellic Acid 200ppm X Cow urine @ 5%)	95.48	157539.68
P_2 x C_2 (Gibberellic Acid 200ppmXCow urine@10%)	97.86	161111.11
P_3 x C_1 (Gibberellic Acid 300ppm X Cow urine @ 5%)	93.81	152380.95
P_3 x C_2 (Gibberellic Acid 300ppmXCow urine@10%)	93.10	152380.95
P_4 x C_1 (Salicylic Acid 100ppm X Cow urine @5%)	89.52	146428.57
P_4 x C_2 (Salicylic Acid 100ppmXCow urine@10%)	89.29	144841.27
P_5 x C_1 (Salicylic Acid 200ppm X Cow urine @5%)	90.24	149603.17
P_5 x C_2 (Salicylic Acid 2100ppmXCow urine@10%)	91.86	150396.83
P_6 x C_1 (Salicylic Acid 300ppm X Cow urine @5%)	89.05	144047.62
P_6 x C_2 (Salicylic Acid 300ppmXCow urine@10%)	88.33	139285.71
SEm±	0.64	1253.33
CD $_{0.05\%}$	1.82	3550.68

Table.4 Interaction effect of plant growth regulators, cow urine and vermiwash on vegetative, floral and corm parameters

Treatments	Emergence of plants (%)	Plant Height (cm.)	50% Spike Initiation (Days)	Spike Length (cm)	Rachis Length (cm)
$P_0C_1V_1$	84.29	74.53	74.58	66.28	50.53
$P_0C_1V_2$	83.33	76.80	74.08	64.72	51.74
$P_0C_2V_1$	82.86	77.99	73.95	64.81	51.80
$P_0C_2V_2$	83.33	78.43	74.29	67.40	50.94
$P_1C_1V_1$	97.62	89.68	66.32	71.98	54.75
$P_1C_1V_2$	94.76	85.19	67.69	70.05	54.38
$P_1C_2V_1$	94.76	87.66	67.82	71.65	54.68
$P_1C_2V_2$	95.24	86.58	68.01	70.12	54.21
$P_2C_1V_1$	96.67	88.73	66.41	70.85	54.57
$P_2C_1V_2$	94.29	86.90	67.89	71.60	54.80
$P_2C_2V_1$	97.14	88.29	67.86	71.97	55.07
$P_2C_2V_2$	98.57	89.89	67.11	71.99	55.50
$P_3C_1V_1$	93.81	84.89	69.52	70.00	53.84
$P_3C_1V_2$	93.81	85.05	70.37	69.11	53.14
$P_3C_2V_1$	93.33	86.56	70.17	68.58	52.65
$P_3C_2V_2$	92.86	84.24	69.63	68.74	52.93
$P_4C_1V_1$	89.05	81.18	73.25	66.89	50.65
$P_4C_1V_2$	90.00	82.60	73.17	67.11	52.30
$P_4C_2V_1$	90.00	81.46	73.22	67.80	51.62
$P_4C_2V_2$	88.57	81.17	73.16	65.74	52.06
$P_5C_1V_1$	91.90	82.11	71.70	65.97	52.11
$P_5C_1V_2$	88.57	82.80	71.40	65.91	50.68
$P_5C_2V_1$	90.48	82.29	71.33	65.61	51.31
$P_5C_2V_2$	93.24	81.41	71.24	66.03	51.56
$P_6C_1V_1$	87.62	83.58	73.64	64.58	49.64
$P_6C_1V_2$	90.48	81.54	73.64	64.72	51.14
$P_6C_2V_1$	90.00	80.88	73.40	64.68	50.49
$P_6C_2V_2$	86.67	83.59	75.03	64.44	48.90
SEm±	0.91	0.87	0.34	0.79	0.36
CD $_{0.05\%}$	2.57	2.48	0.95	2.25	1.02

Rajan and Murugesan (2012) also recorded increased germination percentage (100%) than control (80%) in rice. Sivasubramanian and Ganeshkumar (2004) also observed increased plant height and leaf area over control in marigold.

Effect of interactions of plant growth regulators, cow urine and vermiwash on gladiolus cv. Candyman

The results presented in the Table 3 and 4 clearly depicted that the interaction effect of GA_3 @ 200 ppm along with cow urine @ 10 % (P_2C_2) was found significant which further increased the emergence of plants (97.86 %) and number of corms hectare^{-1} (161111.11**)**.The interactive effect of plant growth regulators, cow urine and vermiwash was also found significant. GA_3 @ 200 ppm along with cow urine and vermiwash each at 10% resulted in highest emergence (97.14 %), plant height (89.89 cm), longest spikes (71.99 cm) and rachis (55.50 cm) while earliest 50 % spikes emergence (66.32 days) was noticed under treatment GA_3 @ 100 ppm along with cow urine and vermiwash each at 5% which inferred that cow urine, vermiwash and plant growth regulators have synergetic effect for improvement on vegetative growth, flowering and corm production when used together rather than alone.

Kumar *et al.,* 2008 also reported that free GA_3 is active in breaking down the reserve food materials by hydrolytic enzyme which might have resulting quick sprouting. According to Mahesh and Misra (1993) GA_3 stimulate cell proliferation and elongation at intercalary meristem levels which helps in increase plant height**.** Increased plant height due to cow urine is also reported by Bhoopathi *et al.,* (2001) in sugarcane and Venkataramana *et al.,* (2009) in mulberry due to vermiwash.

On the basis of results obtained from a two years of experiments, it may be concluded that a comparatively good vegetative growth of gladiolus plants with better quality of flowers and more number of corms could be achieved with application of 200 ppm GA_3 followed by its lower concentration *i.e.* 100 ppm whereas, application of 300 ppm GA_3 was helpful in improving the size and weight of corms. It was also observed that cow urine, vermiwash and plant growth regulators have synergetic effect for improvement on vegetative growth, flowering and corm production when used together rather than alone.

References

Anonymous, 2015. National Horticulture Board, Indian Horticulture Data Base 2014-15. http://www: nhb.gov.in/area-production statistic/ 2015

Ansari, A.A., 2008. Effect of vermicompost and vermiwash on the productivity of spinach (*Spinacia oleracea*), onion (*Allium cepa*) and potato (*Solanum tuberosum*). *World Journal of Agricultural Sciences*, 4(5): 554-557.

Baskaran, V., R.L. Misra and K. Abirami, 2009. Effect of plant growth regulators on corm production in gladiolus *J. Hortl. Sci.,* 4(1): 78-80

Bhalla, R. and A. Kumar, 2008. Response of plant bio-regulators on dormancy breaking in gladiolus. *Journal of Ornamental Horticulture*, 11(1): 1-8.

Bhattacharjee, S.K., 1983. Response of *Lilium tigrinum* Ker-Gawl (tiger lily) to soil drenches application of growth regulating chemicals. *Progressive Hort.*, 15: 204-209.

Bhoopathi, P.K., S. Anbumani, and S. Ravi, 2001. Influence of method of planting and sett treatments on growth attributes of seed cane (*Saccherum officinarum* L.). *Journal of*

Ecobiology, 13(4): 269-273.

Chawla, O.P. 1986. *Advances in biogas technology*. ICAR Publ. New Delhi, p. 109.

Dogra Sheetal, R.K. Pandey and Deep Ji Bhat, 2012. Influence of gibberellic acid and plant geometry on growth, flowering and corm production in gladiolus (gladiolus grandiflorus) under Jammu agro climate. *International Journal of Pharma and Bio Sciences*, 3(4): 1083–1090.

Groot, S.P.C. and C.M. Karssen, 1987. The role of GA_3 in germination. *Planta*, 171: 525.

Hartmann, H.T. and D.E. Kester, 1990. *Plant Propagation*, Prentice-Hall, Englewood Cliffs, NJ.

Hemberg, T., 1965. The significance of inhibitors and other chemical factors of plant origin in the induction and breaking of "rest" period. *In: W. Ruhland (ed.). Encyclopaedia of Plant Physiology*, 15: 669-698.

Ilango, K., V.K. Mallika, A Vanangamudi, R.S. Venkatesh, R.S. Vinaya, and S. Balaji, 1999. Effect of growth stimulants on seed germination and seedling vigour in *Albizia lebbeck* (L). *Seed Research*, 27(2): 188-190.

Joseph, K. and R. Nair. 1989. Effect of seed hardening on germination and seedling vigour in paddy. *Seed Research*, 17(2): 188-190.

Kumar, K.S., S.R. Chandra, M. Padma and Siva. Shankar, 2009. Effect of plant growth regulators on dormancy, corm and cormels production in gladiolus (*Gladiolus x grandiflorus* L.). *Journal of Ornamental Horticulture*, 12(3): 182-187.

Kumar, N. and R.K. Singh, 2007. Effect of sulfosalicylic acid on antioxidant activity of cut gladiolus spikes of different genotypes. *Asian Journal of Horticulture*, 2(1): 37-43.

Kumar, S.P., R. Bhagawati, R. Kumar, and T. Ronya, 2008. Effect of plant growth regulators on vegetative growth, flowering and corm production of gladiolus. *Journal of Ornamental Horticulture*, 11(4): 265-270.

Kumar, V. and R. P. Singh, 2005. Effect of soaking of mother corms with plant growth regulators on vegetative growth, flowering and corm production in gladiolus. *Journal of Ornamental Horticulture* (New Series), 8(4): 306-308.

Lee, K.E., 1988. Earthworms: their ecology and relationships with land use. *Academic Press*, Sydney, pp 411.*

Mares, D.J., H. Marchner and A. Krauss, 1981. Effect of gibberellic acid on growth and carbohydrate metabolism in developing tuber potatoes (*Solanum tuberosum*). *Physiologia Plantarum*, 52: 267-279.

Mazaheri, T.M. and Manochehri-Kalantari, 2007. The effects of salicylic acid on some growth and biochemical parameters of *Brassica napus* L. under water stress. *Isfahan University Journal*, 28(2): 55-66.

Phrimantoro, 1995. Cow Urine as Element of Plant Hara Stockholm Environment Institute, EcoSanRes Series, 2009-1. http://agrotechno-park.blogspot.in/2011/08/cow-urine-as-element-of-plant-hara

Rai, N. and Bansiwal, 2008. Vermiwash: an excellent source of nutrition for plant growth. *Electronic Journal of Environmental Sciences*, 1: 19-21.

Rajan, M.R. and P. Murugesan, 2012. Influence of vermiwash on germination and growth of cow pea (*Vigna ungiculata)* and rice (*Oryza sativa). Journal of Pharmacy Botany Research International*, 4(3): 52-572.

Ramachandrudu, K. and M. Thangam, 2007. Response of plant growth regulators,

coconut water and cow urine on vegetative growth, flowering and corm production in gladiolus. *Journal of Ornamental Horticulture*, 10(I): 38-41.

Ramachandrudu, K. and M. Thangam, 2008. Performance of gladiolus varieties under agro-climatic conditions of Goa. *Journal of Ornamental Horticulture*, 11(2): 91-97.

Rana, P., J. Kumar and M. Kumar, 2005. Response of GA_3 on plant spacing and planting depth on growth, flowering and corm production in gladiolus. *Journal of Ornamental Horticulture*, 8(1): 41– 44.

Sharma, D.P., Y.K. Chattar and N. Gupta, 2006. Effect of gibberellic acid on growth, flowering and corm yield in three cultivars of gladiolus. *Journal of Ornamental Horticulture*, 9(2): 106-109.

Shield, E.B., 1982. p. 128. Raising Earthworms for Profit. Shields Publication. P.O. Box 669 Eagle River Wisconsin.

Sivasubramanian, K. and M. Ganeshkumar, 2004. Influence of vermiwash on the biological productivity of marigold. *Madras Agric. J.*, 91(4-6): 221-225.

Steel, R.G.D. and J.H. Torrie, 1980. p 336-354. Principle and procedures of statistics, second edition. McGraw Hill Book Co. New York.

Venkataramana, P., B. Murthy, R. Narasimha., J.V. Krishna and C.K. Kamble, 2009. Efficacy of foliar sprays of vermiwash and cow dung wash on biochemical and yield attributes and yield of mulberry (*Morus alba* L.). *Karnataka J. Agric. Sci.*, 22(4): 921-923.

Wareing, P.F. 1982. Plant Growth Substances. Proc. of 11th Int. Conf. on plant growth substances, Academic Press, London.

Zhang, Y. 2000. The origin and summary of the theory of the cloning of mammal. *Science and Technical Review*, 2: 10-13.