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Response of tissue culture banana cv. grand Naine to different levels of potassium and methods of irrigation

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Abstract
An experiment on "Response of tissues culture Banana Cv. Grand Naine to different levels of Potassium and methods of irrigation was conducted with different treatment combinations of Potassium (100% K, 75% K and 50% K) and irrigation methods (Ring basin, Ridge and Furrow and Drip). The result revealed that among the different levels of application of potassium highest plant height (l 59.50 cm), pseudo-stem girth (89.79cm), no. of leaves (16.11), suckers (4.33), yield parameters *viz.* no. of hands/bunch (5.51), no. of- fingers (l5.77), weight of fingers (110.62 g), bunch weight (9.41 kg) and yield (30.05 t/ha) was observed in 100%K at 210 DAP. Quality parameters *viz.* TSS (15.66%), total sugar (8.63%) and Ascorbic acid (12.08 mg/l00g of pulp) was also observed in 100% K. Minimum no. of days taken to flower and the highest reducing sugar(5.89%) content was found in 75% K. Drip irrigation was found effective for height (156.83 cm), pseudo-stem girth(l 00.98 cm), no. of leaves (16.1), no. of suckers (4.17), yield parameters *viz.* No. of hands/bunch (5.35), no. of fingers(l5.83), weight of fingers(107.41 g), bunch weight(8.9lkg) and yield (28.58 t/ha) at 210 DAP. Quality parameters *viz.* TSS (15.08%), reducing sugar (5.25%), total sugar (7.98%) and ascorbic acid (11.60 mg/100g of pulp) was found highest in drip irrigation and the highest acidity (0.22%) was found in control.

Keywords: Banana, Grand Naine, potassium, tissue culture, drip irrigation, ring basin, ridge and furrow

Introduction
Banana (*Musa spp*.) is an edible fruit, botanically a berry and *belongs* to the family Musaceae which produce several kinds of large herbaceous flowering plants in the genus *Musa.* Edible banana varieties are mostly hybrids of two wild seeded species namely *Musa acuminata* and *Musa balbisiana.* Banana is composed of mainly water and carbohydrates which provides energy (104 Cal. /100 g.) It is rich in minerals, phosphorus and calcium (Uma *et al.* 1999) [15]. Banana ranks first in production and second in area among the fruits grown in India. It shares in total fruit production is 32 percent from 12 percent area under fruits. The important banana growing states are Maharashtra, Gujarat Tamil Nadu, Karnataka, Andhra Pradesh, Kerala, Orissa, Bihar, West Bengal and Assam. In India the production is 29162.6 MT from an area of 858.1 Ha out of which the production of Nagaland is 116.72 Mt from an area of 7.34 Ha (Saxena *et al.* 2017) [11].

Large quantities of major nutrients especially potassium is necessary for proper growth, high yield and improved fruit quality of banana (Singh *et al.*, 1990) [12]. Potassium is important in catalyzing critical reactions such as respiration, photosynthesis, chlorophyll formation and water regulation (Mengel and Kirkby, 1987) [6]. Proper application of 'K' in bananas increases vigour and disease resistance, improve fruit weight and increase the number of fingers/bunch. Potassium stimulates early shooting and significantly shortens the time required for fruit maturity. Deficiency of potassium shows orange yellow chlorosis of the leaves with brown patches. The mid rib of the leaf curls so the tip of the leaf points to the base of the plant showing eventual death of the leaf tissue. Potassium deficiency leads to deformation of bunches with few fingers per hand and poor fruit filling (Turner and Bull, 1970) [14].

The two vital components of sustainable production and productivity of agriculture are water and nutrient. Due to scarcity of water, the available water should be utilized through water saving irrigation methods so as to increase its yield. The most efficient method of irrigation in India is the drip irrigation method which supply precise amount of water directly to the root zone which gives higher growth, improved yield and quality of produce (Kumar *et al*., 2017) [3]. In general, irrigating banana plantations for every 3-4 days during the hot period and at 7-8 days interval during cool weather is recommended.

Whereas, due to the receding water table, diversion of water to the other activities and reduced availability of water to agriculture, banana farmers are forced to adapt efficient irrigation methods like drip irrigation, which can economize the water use and increase the water use efficiency (WUE). For judicious water management drip irrigation system is well suited to high value crops like banana. The WUE is higher with drip irrigation system when compared to basin system of irrigation. Drip system of irrigation ill not only reduce the quantity of water used but also increases the yield and decreases the number of days to harvest. It saves water up to 50% (Magar and Bhambure, 2000) [5]. Keeping in view the present study was conducted with specific objectives of: to study the effect of different level of potassium and methods of irrigation on vegetative growth, yield attributes and quality parameters.

Methods and Materials

The experiment was conducted at the experimental farm of school of agricultural sciences and rural development (SASRD), Medziphema campus, Nagaland University. The farm was located at an elevation of 305 m above mean sea level with annual average rainfall of 2000-2700 mm with high humidity and temperature ranging between 28-35°C during summer. The experimental plot was laid out in two factor RBD with 16 treatments of different doses of potassium and different methods of irrigation and replicated thrice. Planting of tissue cultured Banana cv. Grand Naine was done at a spacing of 1.8 x 18 m. Recommended dose of manures@326: 625: 500 NPK/g/plant and /FYM of 20Kg/plant were applied. Full amount of P_2o_5 and FYM were applied at the time of planting. Growth parameters like pseudo stem height(cm), pseudo stem girth (cm), number of leaves, number of days taken to flower after maturity, number of suckers and yield parameters like bunch weight(kg), number of hands per bunch, number of fingers per hand, weight of fingers (g), Yield(t/ha) and quality attributes like total soluble sugars(°B), titrable acidity (%), reducing sugars(%), ascorbic acid (mg/100g of pulp), total sugar (%) were recorded.

The data was analyzed by adopting the procedure of two-way analysis of variance (2-way ANOVA) as suggested by Panse and Sukhatme (1985) [8] and the treatment error was tested against error mean square by applying Fisher Snedecor 'F' test of probability at 0.05% level of significance.

Results and Discussion

The data pertaining to the peudostem height (cm), pseudo stem girth (cm), number of leaves, number of days taken to flower after maturity, number of suckers under the different treatments obtained during the course of investigation are represented intable 1. The effect of pseudo stem height was found significant to different levels of potassium. The highest plant height (159.50cm) was recorded in plants treated with 100% K (K_1) and the lowest (129.63) was recorded in control (K_0) at 210 DAP. Similar results were reported by Srinivas (1997) [13] who reported that the pseudo stem height increases with the application of K, whereas in irrigation methods the highest plant height (156.89cm) was recorded in I_3 (drip irrigation) and the lowest in I_0 (control) at 210 DAP. Pramanik and Kumar (2016) [9] reported that drip irrigation increases the pseudo stem height due to higher availability of inputs and regular supply of requisite amount of water through drip might have increased its height. The data on pseudo stem girth was recorded highest in K_2 (75%) at 30DAP where as in irrigation methods the highest pseudo stem girth was recorded in I_3 (9.77, 40.47 and100.98 cm) and the lowest was recorded in control. The highest number of leaves was counted in K_1 (100%K) and lowest at 210 DAP in K_0. Data on number of leaves due to different irrigation methods was recorded maximum in I_3 (16.10) and minimum in I_0 (12.88) at 210 DAP. There was significant increase in the number of leaves on effect of K application. These results were in conformity with the findings of Pandey *et al*., (2001) [7]. The effect of different levels of potassium on the number of days taken to flower was found to be significant. The minimum number of days taken to flowering was found in K_2 (246.50 days) and maximum in K_0 (317.42 days). The minimum number of days taken for inflorescence emerge (241 days) was recorded in I_3 while maximum number of days taken in control. Under drip irrigation, banana plants flowered 15 days earlier as compared to basin irrigation (Hedge and Srinivas, 1990) [12]. Data on the number of suckers production was also found to be significantly higher in plants treated with K_3 (4.33) compared with control K_0. The maximum number of suckers produced by plant I_3 and the minimum number was in I_0 (control).

Table 1: Effect of different levels of potassium and irrigation methods on plant and plant attributing characters of banana cv. Grand Naine

Treatment	Plant height (cm)			Pseudo stem girth (cm)			Number of leaves			Days taken to flower	Number of suckers
	30 DAP	120 DAP	210 DAP	30 DAP	120 DAP	210 DAP	30 DAP	120 DAP	210 DAP		
K_0 (control)	16.19	50.93	129.63	8.16	38.63	80.79	8.00	9.17	11.81	317.42	3.42
K_1 (100% K)	20.19	55.83	159.50	8.86	40.29	89.79	9.50	9.83	16.11	268.17	4.33
K_2 (75% K)	17.92	53.88	158.00	9.52	40.01	89.23	9.42	9.67	15.56	246.50	3.50
K_3 (50% K)	18.25	54.24	154.42	9.02	40.01	89.42	9.17	9.25	15.23	257.83	3.67
SE m±	0.89	0.77	0.49	0.37	0.68	0.72	0.24	0.19	0.13	5.71	0.17
CD at 5%	2.58	2.23	1.43	NS	NS	2.08	0.70	0.54	0.37	16.49	0.49
I_0 (Control)	17.19	52.65	143.46	8.70	39.43	77.50	8.88	9.13	12.88	285.50	3.46
I_1 (Ring Basin)	18.63	53.61	146.92	8.44	39.43	83.50	8.75	9.25	14.59	277.25	3.79
I_2 (Ridge and Furrow)	17.19	53.10	154.33	8.65	39.71	87.25	9.00	9.75	15.15	286.17	3.50
I_3 (Drip Irrigation)	19.53	55.53	156.83	9.77	40.47	100.98	9.46	9.79	16.10	241.00	4.17
S.Em ±	0.89	0.77	0.49	0.37	0.68	0.72	0.24	0.19	0.13	5.71	0.17
CD at 5%	NS	NS	1.43	NS	NS	2.08	NS	0.54	0.37	16.49	0.49

The data on the yield and yield attributing characters (table 2.) was influenced by different levels of potassium and irrigation methods presented in Table 2. The highest bunch weight was recorded in K_1 (9.41Kg) and the lowest in K_0 (6.35 Kg)

whereas irrigation has influenced yield significantly (Plate-I). Highest bunch weight (8.80Kg) was found in I_3 while lowest in I_0 (7.13 Kg). Perusal of the data showed that there was significant difference on the hands/bunch due to different levels of potassium but recorded non-significant results on irrigation methods. The maximum number of hands per bunch was recorded in K_1 (5.51) and the minimum in K_0 (4.72). Whereas irrigation methods showed non-significant on hands per bunch and recorded highest in I_3 (8.80) and lowest in I_0 (7.13) respectively. It is revealed from the data that the effect of different levels of potassium and irrigation methods was found to be significant. The heaviest finger weight was recorded in K_1 (110.62g) and the least was recorded in K_0 (91.21g) and the heaviest finger weight as influenced by irrigation methods was recorded in I_3 (107.41g) and the lightest finger weight was recorded in I_0 (94.23g). Maximum yield was recorded in K_1 (30.05 t/ha) and lowest (19.20 t/ha) in K_0. Where as in irrigation methods yield was recorded highest (28.58 t/ha) in I_3 and the lowest (22.11 t/ha) in I_0. Also similar results had been reported by Kavino *et al*., 2002 [4], revealed that with higher level of NPK fertilizer application and drip irrigation gives maximum yield. The reason for low yield in surface irrigation might be due to the water stress during the last few days before irrigation.

Table 2: Effect of different levels of potassium and irrigation methods on yield and yield attributing characters of banana cv. Grand Naine

Treatment	Bunch weight (Kg)	Number of hands/bunch	Weight of fingers (g)	Yield (t/ha)
K_0 (control)	6.35	4.72	91.21	19.20
K_1 (100% K)	9.41	5.51	110.62	30.05
K_2 (75% K)	7.83	5.21	96.65	23.97
K_3 (50% K)	8.45	5.13	105.44	26.04
SE m±	0.31	0.14	1.47	1.02
CD at 5%	0.91	0.42	4.26	2.93
I_0 (Control)	7.13	5.05	94.23	22.11
I_1 (Ring basin)	7.59	5.08	98.47	23.43
I_2 (Ridge and Furrow)	8.40	5.09	103.82	25.14
I_3 (Drip Irrigation)	8.91	5.35	107.41	28.58
S.Em ±	0.31	0.14	1.47	1.02
CD at 5%	0.91	NS	4.26	2.93

The perusal of data regarding fruit quality attributes were presented in Table 3. Showed that highest TSS (15.66°B) was recorded in K_1 and the lowest (13.25°B) in K_0. With reference to highest TSS (15.08°B) was recorded in I_3 and the lowest (14.06°B) was in I_0. The data presented in Table 3. Revealed that there was significant difference in the acidity due to the effect of different levels of potassium and irrigation methods. The highest acidity (2.22%) was recorded in control and the lowest in (0.18%) in K_2, where as in irrigation methods highest acidity (0.23%) was observed in I_0 and lowest in (0.17%) in I_3. The highest reducing sugars was found in K_2 (5.89%) and the lowest was in K_0 (3.64%). There was no significant difference in irrigation methods and the highest reducing sugar was found in I_3 (5.25%) and the lowest in I_2 (4.71%). Higher fruit quality especially sugar content is due to the breakdown and translocation of starch, synthesis of protein and neutralization of physiological important organic acid by potassium in carbohydrate synthesis. This is in conformity with Santosh and Tiwary, (2017) [10]. Highest total sugar (8.63%) was found in K_1 and the lowest in control. Whereas the total sugar content showed no significant difference to irrigation methods. Highest sugar content was found in I_3 (7.98%) lowest in I_1 (7.29%). Ascorbic acid content shown significant variation to different levels of potassium. Highest ascorbic acid content was observed in K_1 (12.0 mg/100 g of pulp) and lowest in K_0 (8.31 mg/100g of pulp). Whereas no significant difference was shown in irrigation methods. The highest was recoded in I_3 (11.60 mg/100 pulp) and lowest in I_1 (9.88 mg/100g pulp). Increased ascorbic acid content in the fruits due to potassium could have helped down the enzymatic system that encouraged the oxidation of ascorbic acid, thus helping the plants to accumulate more ascorbic acid content in the fruits (Bhargava *et al*., 1993) [1].

Table 3: Effect of different levels of potassium and irrigation methods on quality attributes of banana cv. Grand Naine

Treatment	TSS (%)	Acidity (%)	Reducing sugar (%)	Total sugar (%)	Ascorbic Acid (ml/100 g of pulp)
K_0 (control)	13.25	0.22	3.64	6.64	8.31
K_1 (100% K)	15.66	0.19	5.82	8.63	12.08
K_2 (75% K)	14.58	0.18	5.89	8.16	10.45
K_3 (50% K)	15.15	0.20	4.90	7.32	11.80
SE m±	0.17	0.01	0.18	0.38	0.56
CD at 5%	0.50	0.03	0.53	1.11	1.62
I_0 (control)	14.06	0.23	5.08	7.64	9.94
I_1 (ring basin)	14.42	0.20	5.21	7.29	9.88
I_2 (ridge and Furrow)	15.07	0.20	4.71	7.85	11.23
I_3 (drip Irrigation)	15.08	0.17	5.25	7.98	11.60
S.Em ±	0.17	0.01	0.18	0.38	0.56
CD at 5%	0.50	0.03	NS	NS	NS

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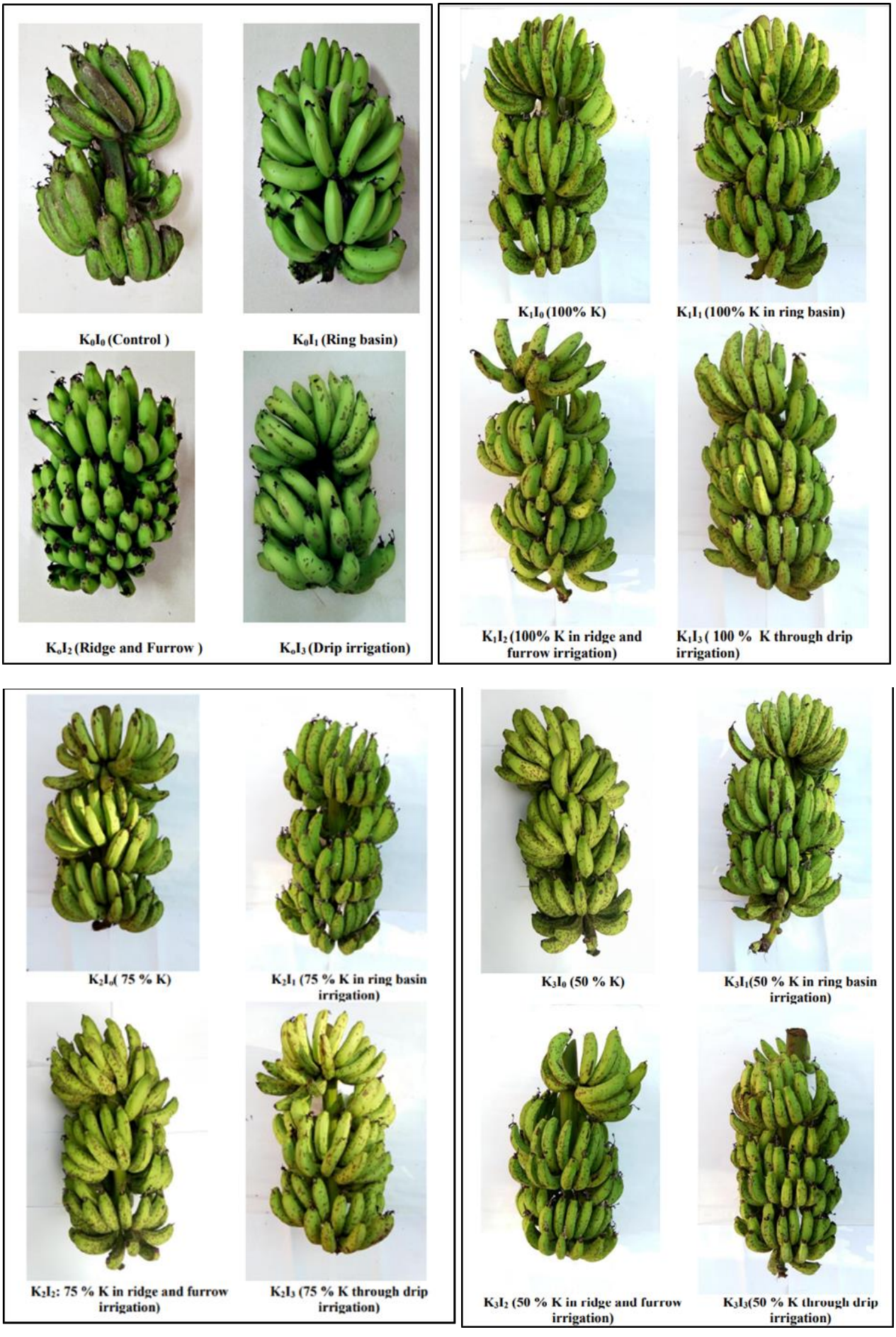

Plate I: Fruits treated with different levels of potassium and irrigation methods

Conclusion

Based on the experimental findings, the following conclusion can be drawn from the present investigation: 1. The effect of different levels of potassium and irrigation methods on tissue culture banana cv. Grand Naine was found effective in 100% K and drip irrigation (K1I3) followed by 75% K and ridge and furrow (K2I2). 2. The yield and yield attributing characters of tissue culture banana cv. Grand Naine was found increase by applying 100% K and drip irrigation (K1I3)

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