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IMPACT OF FRONT LINE DEMONSTRATION ON DE-NAVELLING AND STALK-END NUTRIENT APPLICATION IN BANANA

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ABSTRACT
A demo was conducted at farmer's field under Front Line Demonstrations during 2013-12 to 2015-16 in Krishi Vigyan Kendra, Kalyandurg Anantapur district of Andhra Pradesh, to study the impact of denavelling and stalk-end nutrient application of urea and sulphate of potash on the improvement of bunch weight of banana cultivar cv. Grand Naine. The denavelled distal stalk end of the bunch was fed with urea, sulphate of potash blended with fresh cowdung soon after the fruit set. The results showed that when the bunch was fed with urea (7.5g), sulphate of potash (7.5g) blended with 500 g fresh cowdung (T_1) all the yield attributing characters *viz.*, bunch weight (25.72kg), number of hands per bunch (9.34), number of fingers per hand (13.43), hand weight (2.31kg), yield per plant, per hectare (64.10t). The minimum of all these characters and bunch weight were obtained in control (T_2) where male bud was retained till harvest. The results revealed that the nutrients moved from the blend into the bunch and significantly enhanced the weight of fruits and bunch. When the bunch was fed with urea 7.5 g, sulphate of potash 7.5 g blended with cowdung 500 g (T_1) the yield response was 7.44 per cent, benefit cost ratio 1.17:1 and net returns Rs. 24,847 increase over the control.

KEY WORDS: Denavelling, stalk-end nutrient application, urea, sulphate of potash, cow dung, bunch yield and economics.

INTRODUCTION:

Banana and plantain (*Musa* sp.) are widely grown in India with great socio-economic significance, interwoven in the cultural heritage of the country. Banana is fourth important food crop in terms of gross value exceeded only by paddy, wheat and milk products and forms an important crop for subsistence farmers. It is also a dessert fruit for millions apart from a staple food owing to its rich and easily digestible carbohydrates with a calorific value of 67–137/100g fruit. Being a rich source of vitamin C and minerals, it makes healthy and salt-free diet. Owing to its multifaceted uses from underground stem up to the male flower it is referred as *Kalpatharu* (a plant of virtues). In India, banana contributes to 31.72% of the total fruit production. India leads the world in banana production and accounts for about 25.6 % among fruit crops and occupies about 0.796 million hectare with an annual production of 28.45 million tonnes (NHB, 2014). Andhra Pradesh, Assam, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa and West Bengal are major banana growing states, the highest productivity being 52.18 tonnes/ ha in Maharashtra followed by Gujarat (40 tonnes/ha). The lowest productivity is from the north-eastern region. In South East Asian countries manipulation of fruit size to enhance the size of fingers is a common practice (Kotur and Keshava Murthy, 2008). To supplement nutrients applied to banana plant through soil and foliage, de-navelling (removal of male inflorescence) and post shooting feeding through the distal stalk-end of the rachis have gained importance (Kumari, 1986; Ancy *et al*., 1998 and Ancy and Kurien, 2000). De-navelling serves dual purpose of saving mobilization of food into the unwanted sink of banana plant and also earns additional income when the excised male bud is used as a vegetable (Singh, 2001). Banana owing to its large size and rapid growth rate require relatively large amount of nutrients for high yields of quality fruits and it is estimated that 50 tonnes of banana in one hectare removes 320kg N, 32kg P_2O_5 and 925kg K_2O every year (Lahav and Turner, 1983). Application of inorganic fertilizers though increases the yield substantially but could not able to sustain the fertility status of the soil (Bharadwaj and Omanwar, 1994) and have caused several undesirable consequences in the fragile soil eco-system, leading to gradual decline in productivity. Bhalerao *et al*. (2009) observed that combined application of 100 per cent recommended dose of NPK along with organic manures increased the growth and also yield attributes. Similar trend was also reported by Barakat *et al.* (2011) in banana. For obtaining high yield with superior quality bananas, adequate supply of plant nutrients with irrigation and improved cultural practices are of prime importance. Studies conducted so far in India have revealed that considerable yield increment in banana could be achieved by adequate supply of nutrients. Among the major plant nutrients nitrogen and potash are required in large quantities for the growth, development and yield. Nitrogen acts as a chief promoter to build up a strong vegetative frame at the early phase which decides the productivity of banana plant. Post shooting application of urea has been reported to promote yield in banana because urea is readily absorbed by the banana plant. Banana being heavy feeder requires very large quantity of nutrients for growth and yield, accounting for 20–30% of the total cost of production. Choice and quantum of fertilizers, time of application, mode of application and frequency of

application vary depending upon cultivar, production system and agro climatic conditions. Banana is a potassium loving crop and high potassium availability is important at fruiting stage. Any limitation in the supply of nutrients at the shooting stage affects bunch size and quality in banana. Among the several factors affecting fruit quality, adequate potassium application is considered to be of utmost importance in banana cultivation. Potassium is known to influence fruit yield in general and fruit quality in particular (Tandon and Sekhon, 1988). Many reports have indicated the usefulness of post shooting spray of various SOP during fruit development in influencing the fruit yield, shelf life and quality Algarsamy Ramesh Kumar and Neelakandan (2008) in Robusta, Ramesh Kumar and Kumar (2007 and 2010) in cv. Ney Poovan and Ramesh Kumar *et al.* (2008) in cv. Robusta and Madhu (2013) in banana cv. Grand Naine.

Banana being a gross feeder requires high amount of nutrients for proper growth and production. Its nutritional requirement is estimated to be around 320 kg N, 32 kg P_2O_5 and 925 kg K_2O per ha per year (Lahav and Turner, 1983). Under traditional farming system, banana crop receives its last dose of fertilizers (nitrogen and potassium) at 7th month after planting *i.e.* just before shooting, which has to support the requirement of nutrients until harvest since large quantity of photosynthates are to move from the source to the sink *i.e.* developing bunches at this phase. Any limitation in the supply of nutrients at this crucial stage affects the bunch size and quality. Because of this problem, poor filling and development of fingers is often reported. Hence, an additional dose of fertilizer after shooting has become imperative. However, it is not wise to go for soil application of fertilizers at finger development stage, since the uptake is slow and low (Veerannah *et al*., 1976). Many reports have indicated the usefulness of post shooting spray of various nutrients during fruit development in influencing the fruit yield, shelf life and quality (Kannan, 1980). Banana has been found to be responding well to potash spray supplied through muriate of potash (MOP) or potassium dihydrogen phosphate (KH_2PO) (Mahalakshmi, and Sathiyamoorthy, 1999). However, the effect of urea, sulphate of potash (SOP) and cowdung the combined effect of these nutrients as a post shooting applicant in banana has been assessed earlier at Indian Institute of Horticulture Research, Bangalore. With all these background, an investigation was carried out at to study the influence of these nutrients on yield and quality of banana

MATERIALS & METHODS

Krishi Vigyan Kendra, Kalyandurg, has conducted 11 FLDs under real farming situations between 2013 and 2016 in 7 different villages located in different blocks under KVK operational area. Experimental research design was used for the study total population of 11 farmers (N=11) in whose plots FLDs were conducted along with control plot was taken into consideration for the study to find out the effect of denavelling and stalk-end nutrient application in banana. The area under each demonstration was 0.8 ha (8000 m^2) from each location consisting of 0.2 ha (2000m^2) each of demo and control plots. The details are given in Table.1.

TABLE 1: Particulars of Front Line Demonstration

S.no.	Year	No. of villages	No. of locations	Area (ha)	
				Demo	Control
1	2013-14	4	4	3.2	0.8
2	2014-15	2	4	3.2	0.8
3	2015-16	2	3	2.4	0.6
Total		7	11	8.8	2.2

The demonstration comprised of two treatments *viz*., T_1-Denavelling, stalk-end nutrient application with 7.5g of urea, 7.5g of sulphate of potash and 500g of cow dung for each bunch and T_2-Farmers practice (without bunch feeding). The method used for the experiment involved excising the distal end of the bunch along with the male bud by giving a slanting cut (10-15cm below the last hand) immediately after the pistillate (female) flowers had formed into fruits that is 5 – 7 days after opening of the last hand in the bunch. Blending of the required dose of chemicals (urea and SOP) 7.5 g each and 500 g fresh cowdung with 100ml of water was done to form slurry (Plate.1). The blend was placed in a polythene bag and tied securely to dip the excised rachis into the slurry. Technology effectiveness is the intervening variable which refers to the performance of technology in terms of quality and yield of banana. Data on yields, expenditure incurred by the farmer on control (Farmer's practice) and demo plots were collected and analyzed. Gross income was calculated based on local market prices of banana and net income by subtracting the total cost of cultivation from gross income. Benefit: cost ratio was computed by dividing gross returns with cost of cultivation. Even though N, K is abundant in many banana growing soils, the bulk of soil K is unavailable to plants due to both plant and environmental factors therefore additional application through bunch feeding has been found beneficial. In high value crop like banana quality standards have become the most important factor influencing yield and farmer's income. The main aim of this study was to assess the effect of post shooting bunch feeding of urea, sulphate of potash and cow dung for quality characters of banana cv. Grand Naine under Anantapur soil.

RESULTS & DISCUSSION

Yield attributes

Due to application of urea and sulphate of potash combined with fresh cowdung as bunch feeding a marked effect on bunch characteristics was observed in the present demo. The yield performance indicators are presented in Table 2.

TABLE 2: Effect of denavelling and stalk-end nutrient application on bunch characteristics of banana

Year	Bunch weight (kg)		No. of hands/bunch		No. of fingers/hand		Hand weight (kg)	
	Demo	Control	Demo	Control	Demo	Control	Demo	Control
2013-14	25.96	24.34	9.03	8.57	12.76	11.01	2.13	1.82
2014-15	26.76	22.28	9.76	8.87	13.91	12.62	2.46	2.02
2015-16	24.45	20.89	9.23	8.02	13.64	11.24	2.35	1.96
Average	25.72	22.50	9.34	8.48	13.43	11.62	2.31	1.93

Demo- Recommended practice, Control- Farmers practice,

The data presented in Table 2 revealed that under demo plot, the performance of banana yield was found to be substantially higher than that under control (farmer practices) during all the years (2013-14 to 2015-2016). The bunch weight (kg) of banana under demo recorded were 25.96, 26.76 and 24.45 kg/bunch, in compared to control 24.34, 22.28 and 20.89 kg/bunch during 2013-14, 2014-15 and 2015-16 respectively. The cumulative effect of technological intervention over three years, revealed an average bunch weight were 25.72 kg/bunch in compared to control 22.50 kg/bunch (Plate.2). The numbers of hands per bunch of banana under demo recorded were 9.03, 9.76 and 9.23, compared to control 8.57, 8.87 and 8.02 during 2013-14, 2014-15 and 2015-16 respectively. The cumulative effect of technological intervention over three years, revealed an average number of hands per bunch of 9.34, whereas in control 8.48. The numbers of fingers per hand of banana under demo recorded were 12.76, 13.91 and 13.64 in compared to control 11.01, 12.62 and 11.24 during 2013-14, 2014-15 and 2015-16 respectively. The cumulative effects of technological intervention over three years, revealed an average number of hands per bunch were 13.43, in compared to control 11.62. Similar to the present findings Bhargava *et al*. (1993) also stated that potassium improves fruit weight and number of fruits per bunch, and increases the content of total soluble solids, sugars and starch. Vadivel and Shanmugavelu (1978) found that potassium supply affects the fruit quality of banana by affecting the reducing sugars. The hand weight of banana under demo recorded were 2.13, 2.46 and 2.35kg in compared to control 1.82, 2.02 and1.96kg during 2013-14, 2014-15 and 2015-16 respectively. The cumulative effects of technological intervention over three years, revealed an average hand weight of banana were 2.31kg in compared to control 1.93kg. Addition of sulphate of potash to the blend increased potash content thereby increases the yield parameters (Kotur and Keshava Murthy, 2008). However, tying urea at the rachis promoted the yield of bunch and hand because of the availability of urea in aqueous form at later stages for a prolonged period. It was reported that when ammonium sulphate or urea and sulphate of potash were blended in cowdung, an enhanced increase in nitrogen content was observed in all parts of bunch but nitrogen content of fruits showed a significant decrease as compared to feeding with ammonium sulphate alone, this may be due to the dilution caused by the substantial increase in dry (weight) matter of fruits. The addition of sulphate of potash in the blend increased Ndff (nitrogen derived from fertilizer) significantly over the blending of ammonium sulphate alone. Direct relationship existed between nitrogen content and bunch weight (Kotur and Keshava Murthy, 2008). Removal of male bud caused an increase in weight because conservation and utilization of energy for finger development which would be otherwise lost for opening of the remainder of the flower and removal of a strong and active competing sink for photosynthesis, despite its smaller size relative to the bunch (Kurien *et al*., 2000; Ancy and Kurien, 2000; Singh, 2001 and Kotur; Keshava Murthy, 2008). Burhagohain and Shanmugavelu (1986) also reported the exogenous feeding and translocation of nutrients into the bunch in banana variety 'Poovan (AB)', 'Monthan (AAB)' and 'Nendran (AAB)'. It was reported that the urea enhance the urease activity in the fruits (Ancy, *et al.*, 1998, Kotur and Keshava Murthy, 2008).

TABLE 3: Cost economics of denavelling and stalk-end nutrient application in banana

Year	Yield t/ha		% increase in yield	Gross expenditure Per hectare (Rs)		Gross returns/ha (Rs)		Net returns/ha (Rs)		B:C ratio	
	Demo	Control		Demo	Control	Demo	Control	Demo	Control	Demo	Control
2013-14	64.90	60.85	6.7	1,73,965	1,72,500	3,89,400	3,65,100	2,15,435	1,92,600	2.23	2.11
2014-15	68.30	62.95	8.5	1,74,070	1,72,500	3,75,650	3,46,225	2,01,580	1,73,725	2.15	2.00
2015-16	59.10	55.20	7.06	1,80,000	1,78,500	3,84,150	3,58,800	2,04,150	1,80,300	2.13	2.01
Average	64.10	59.66	7.44	1,76,011	1,74,500	3,83,066	3,56,708	2,07,055	1,82,208	2.17	2.04

Demo- Recommended practice, Control- Farmers practice.

The data presented in Table 3 revealed that under demo plot, the performance of banana yield was found to be substantially higher than that under control (farmer practices) during all the years (2013-14 to 2015-2016). The yield of banana under demo recorded was 64.90, 68.30 and 59.10 t/ha during 2013-14, 2014-15 and 2015-16 respectively. The yield enhancement due to technological intervention was to the tune of 6.70, 8.50 and 7.06 per cent over control (farmer practices). The cumulative effect of technological intervention over three years, revealed an average yield of 64.10 t/ha, 7.44 per cent higher over control. The year-to-year fluctuations in yield and cost of cultivation can be explained on the basis of variations in prevailing social, economical and microclimatic condition of that particular village. It was reported that the addition of sulphate of potash to the blend increased potash content thereby increase the yield parameters (Kotur and Keshava Murthy, 2008). However,

tying urea at the rachis promoted the yield of bunch and hand because of the availability of urea in aqueous form at later stages for a prolonged period.

PLATE 1. Application of stalk-end nutrients with urea+SOP+cowdung and bunch feeding

PLATE 2. Banana bunch feeding with nutrients and without bunch feeding (control)

Economic indicators i.e. gross expenditure; gross returns, net returns and BC ratio of Front Line Demonstration are presented in Table 3. The data clearly revealed that, the net returns from the demo plot were substantially higher than control plot, *i.e*. farmers practice during all the years of demonstration. Average net returns from demo plot were Rs 2,07,055/ha in compared to control i.e. Rs 1,82,208/ha. The gross expenditure from the demo plot were Rs. 1,76,001/ha in compared to control Rs. 1,74,500/ha. The gross returns from the demo plot were Rs. 3,83,066/ha in compared to control Rs. 3,56,708/ha. Economic analysis of the yield performance revealed that benefit cost ratio of demonstration plots were observed significantly higher than control plot *i.e*., farmer practice. The benefit cost ratio of demonstrated and control plots were 1.23, 2.15 and 1.13 and 1.11, 1.90 and 1.01 during 2013-14, 2014-15 and 2015-16 respectively. The cumulative effect of technological intervention over three years, revealed an average benefit cost ratio were 1.17 in compared to control 1.04.

Significance of differences among demo and control plots with respect to important indicators:

In order to test the effectiveness of denavilling and stalk end nutrient application technique statistically 't' test was applied to find out, whether there is any significant difference existed between the demo and control plots in terms of bunch weight (kg), number of hands per bunch, number of fingers per hand, Hand weight (kg) and Yield (t/ha) which is presented in Table.4

TABLE 4: Significant difference between important parameters in demo over control for three years (2013 to 2016) **(n-11)**

S.no.	Components	Mean yield		Mean difference	't' – cal value
		Demo	Control		
1	Bunch weight (kg)	25.72	22.50	3.22	4.94**
2	No. of hands/bunch	9.34	8.48	0.86	2.84*
3	No. of fingers/hand	13.43	11.62	1.81	2.96*
4	Hand weight (kg)	2.31	1.93	0.38	3.34*
5	Yield (t/ha)	64.10	59.66	4.44	5.67**

**significant at 0.01 level of probability *significant at 0.05 level of probability

Average bunch weight over three years in demo plot was 25.72 kg compared to 22.50 kg in control by registering a 3.22 kg additional bunch weight. It indicates that due to feeding of bunch with nutrient by cutting navel portion direct uptake was taken place as a result of which gain in weight was observed. In case of number of hands per

bunch there were 9.34 in demo plot compared to 8.48 in control. With respect to number of fingers per hand there were 13.43 in demo plot compared to 11.62 in control. As per as hand weight is concerned average weight in demon plot was 2.31 kg compared to 1.93 kg in control. Average yield per hectare in demo was 64.10 t/ha compared to 59.66 t/ha in control registering 4.4 t/ha additional yields. The perusal of Table-4 clearly revealed that there was significant difference in bunch weight (kg), number of hands per bunch, number of fingers per hand, Hand weight (kg) and Yield (t/ha) between demo and control plots.

CONCLUSION

Bunch feeding with urea and sulphate of potash with cow dung had positive effects on bunch parameters. The results demonstrated that supplementing urea and sulphate of potash application through bunch feeding increased bunch weight, number of hands per bunch, number of fingers per hand, hand weight, yield per hectare (t) and economic parameters as compared to control.

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