

## Effect of planting technique and fertigation on growth, yield and quality of banana (*Musa* sp)

B.S. RASKAR<sup>1</sup>

Water Management Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra 413 722

Received : December 2002

### ABSTRACT

An experiment was conducted during 1997–98 and 1999–2000 to assess the effect of planting technique and fertigation through drip on the growth, yield and quality of banana (*Musa* sp.). Twelve treatments comprising 2 fertilizer sources [water-soluble and straight (N through drip)], 3 fertilizer levels [50, 75 and 100% of recommended fertilizer (444:178:888 kg N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O/ha)] and 2 planting systems [ normal planting (1.5 m × 1.5 m) and triangular paired planting (0.90–2.10 m × 1.5 m) along with surface method of irrigation using straight fertilizer as usual were tried in factorial randomized block design with 3 replications. Banana yield was significantly higher under normal planting than paired planting, resulting 11.38 % higher fruit yield. The yield of banana was increased significantly where water-soluble fertilizer used in fertigation compared to straight fertilizer. The yield, pulp : peel ratio and total soluble solids (TSS) were increased significantly by application of 100% recommended dose of fertilizer. Application of 50% recommended fertilizer dose through drip, resulted in 50% of fertilizer saving than surface irrigation. Water-use efficiency under drip at 100% fertilizer level was more than double compared to surface method of irrigation (2.18 kg/ha-cm). The returns and benefit : cost ratio were significantly higher in normal planting in straight fertilizer with N through drip and application of 100% recommended dose of fertilizer than those observed under the treatments of paired planting straight fertilizer and lower fertilizer levels.

**Key words :** Banana, Planting technique, Fertigation, Yield

Drip irrigation facilitates avoiding stress of water but simultaneously provides an optimal aeration in the soil thereby increasing yields and saving water. Berad (1996) at Rahuri reported that about 30–50% water saving and 10–20% higher productivity of banana could be obtained under drip irrigation than that of gravity irrigation methods. However, in the context of higher fixed cost of drip system it is almost essential to involve suitable plating for economic adoption of drip irrigation system. The benefit of drip irrigation systems can be further elevated using water-soluble fertilizers in fertigation. The adoption of fertigation has shown favourable results in terms of fertilizer use efficiency, water use efficiency and quality of produce (Kumar and Singh, 2002). Banana which is heavy feeder of nutrients, the most efficient method of fertilizer application with its splitting to get maximum fertilizer-use efficiency and net profit should be evolved. Frequent nutrient application have improved the fertilizer application efficiency and reduction of 25–50% in total fertilizer application using drip irrigation as compared with surface broadcasting (Parikh *et al.*, 1993). In view of this, the present investigation, an effect of water-soluble fertilizers

applied through drip and planting technique on the growth, yield and quality of banana was undertaken.

### MATERIALS AND METHODS

A field experiment was conducted during the season of 1997–98 (plant crop) and 1999–2000 (ratoon crop) at Rahuri. Twelve treatments comprising 2 planting techniques, viz. normal planting (1.5 m × 1.5 m) and triangular paired planting (0.90–2.10 m × 1.5 m); 2 fertilizer sources, viz water-soluble and straight (N through drip); 3 fertilizer levels, viz. 50, 75 and 100% of recommended fertilizer (444 : 178 : 888 kg N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O/ha), were tried in factorial randomized block design with 3 replications. These treatments were also compared with surface method of irrigation using straight fertilizer as usual.

Tissue culture plantlets of banana (cv. 'Basrai') were planted in plots of 13.5 m × 6 m on 15 August 1997 and ratoon of the same crop was maintained during the second season in first week of January 1999. In normal planting under drip, ridges and furrows of 75 cm width were opened continuously and alternate furrows were planted by keeping 1.50 m plant-to-plant spacing. While in paired

<sup>1</sup>Present address : <sup>1</sup>Sorghum Improvement Project, MPKV, Rahuri, Maharashtra 413 722

row planting ridges and furrows were opened at 90 cm width. Every 2 rows were planted skipping every third row in triangular fashion by keeping 1.50 m plant-to-plant spacing within line. In surface method, irrigation furrows of 0.75 m width were opened and planting was undertaken keeping 1.5 m × 1.5 m plant spacing. In surface method, irrigations were scheduled at 75 mm CPE using 8 cm depth of irrigation water while in drip alternate day application of water was followed on climatologically approach considering various crop factors at different growth stages. The fruits of banana were harvested up to end of December 1998 during the first season and up to end of April 2000 during the second season. The water-soluble fertilizers through drip were applied in 40 weekly splits (Table 1). In straight fertilizer full dose of phosphate and potash was applied at planting while N (urea) was applied through drip in 32 weekly splits from planting with 15 : 40 : 25 : 20 proportion for every 8 weeks in succession.

## RESULTS AND DISCUSSION

### **Growth and yield-contributing characters, yield and water-use efficiency**

Growth and yield-contributing characters such as plant height, stem girth, hands/bunch, fingers/bunch and bunch weight, were significantly higher in normal planting as compared to paired row planting when 2 years data pooled (Table 2).

The plant height and bunch weight were increased significantly by fertigation of water-soluble fertilizer than straight fertilizer, however the water-soluble fertilizer exhibited their superiority in improving rest yield-contributing characters over application of straight fertilizer. All these characters increased significantly with the increase fertilizer levels from 50% to 100% and it was higher at 100 % RDF but the stem girth and hands/bunch were on par with 75% RDF. In surface method of irrigation, all the yield-contributing characters were found minimum as compared to drip irrigation (Hegde and Shrinivas, 1990). Banana yield was significantly higher under normal planting than paired planting, showing 11.38% higher fruit yield (Table 2). This could be due to sub-optimal utilization of radiant energy in paired planting which resulted

unnecessary competition in paired planting. The result confirm the findings of Daniel *et al.* (1985). Banana fruit yield was also increased significantly owing to application of water-soluble fertilizers through drip than straight fertilizer in which N was applied through drip alone. The difference in yield was mainly due to supply of NPK at time through water-soluble fertilizer (WSF). Yield of banana increased with an increase in levels of fertilizer. Application of 100% recommended fertilizer resulted significantly higher fruit yield (75.72 tonnes/ha) when compared to that 50 and 75% RDF, which were higher, by 13.93 and 6.85% respectively. Similarly, 75% RDF (70.86 tonnes/ha) resulted in significantly more fruit than 50 % RDF (66.46 tonnes/ha); Indicating that application of 100% recommended dose was necessary for getting higher fruit yield of banana. Singh *et al.* (1977) also reported similar results. Application of 100% RDF resulted into improved physiological and metabolic activities, resulting in significant increase in yield. The yield of banana under drip with 50% RDF was numerically higher than the conventional method of fertilizer application and irrigation, resulting in 50% of fertilizer saving under drip. The increase in fruit yield due to normal planting, water-soluble fertilizer and 100% recommended dose was 14.89, 10.89 and 16.24%, respectively, over surface irrigation (Table 2).

The water-use efficiency was found to be higher in normal planting and water-soluble fertilizer than paired planting and straight fertilizer and it was maximum in 100% RDF (5.25 kg/ha-cm).

Water-use efficiency under drip at 100% RDF was more than double compared to surface method of irrigation (2.18 kg/ha-cm), where 299 cm of irrigation water required compared with 144 cm in drip method. Thus the irrigation water saving due to drip was 51.83% over surface irrigation.

### **Quality parameters**

The quality parameters in banana were not differed significantly due to planting system. But these parameters were significantly improved due to application of water-soluble fertilizer through drip compared to N through drip alone. The pulp : peel ratio and total soluble solids (TSS) were increased significantly by application of 100% RDF

Table 1. Fertigation schedule of water-soluble fertilizers for banana

Nutrient (%)	Time of application of water-soluble fertilizer				
	1-8 weeks	9-16 weeks	17-24 weeks	25-32 weeks	33-40 weeks
N	16.0	39.0	25.0	20.0	
P <sub>2</sub> O <sub>5</sub>	30.3	49.5	20.2		
K <sub>2</sub> O	6.0	7.9	21.3	29.5	35.3

Recommended dose of fertilizer (N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O kg/ha), 444 : 178 : 888 kg

**Table 2.** Growth, yield parameters and quality of banana as influenced by treatments (pooled data of 2 years)

Treatment	Plant height (cm)	Stem girth (cm)	Hands/ bunch	Fingers/ bunch	Bunch weight (kg)	Pulp: peel ratio	T.S.S. (%)	Acidity (%)	Fruit yield (t/ha)	WUE (kg/ha-cm)	Net returns (Rs/ha)	Benefit : cost ratio
<i>Planting system (drip)</i>												
Normal	158.49	60.49	7.73	149.99	16.84	2.86	20.33	0.158	74.84	5.19	110,281	1.96
Paired	155.15	57.69	7.30	137.60	15.12	2.83	20.29	0.159	67.19	4.66	94,139	1.87
CD (P=0.05)	2.57	0.54	0.31	4.97	0.43	NS	NS	NS	1.90		5,900	
<i>Sources of fertilizer (drip)</i>												
Straight	155.70	58.96	7.47	142.14	15.70	2.73	20.16	0.156	69.78	4.84	118,370	1.94
Water soluble	157.94	59.23	7.56	145.43	16.26	2.97	20.46	0.160	72.24	5.01	86,050	1.89
CD (P=0.05)	1.70	NS	NS	NS	0.43	0.04	0.05	0.002	1.90		5,900	
<i>Levels of fertilizer (drip)</i>												
50% RDF	155.57	54.12	7.01	133.7	15.18	2.74	20.23	0.164	66.46	4.61	91,095	1.89
75% RDF	156.35	59.54	7.59	142.82	15.72	2.87	20.32	0.158	70.86	4.92	102,210	1.92
100% RDF	158.54	59.61	7.93	154.83	17.05	2.92	20.38	0.154	75.72	5.25	109,325	1.94
CD (P=0.05)	2.05	0.66	0.37	6.03	0.52	0.05	0.06	0.002	2.28		6,840	
Control*	146.00	49.00	7.39	130.97	16.27	2.78	20.32	0.158	65.14	2.18	112,001	2.34

\*Surface irrigation with normal planting and 100 % RDF through straight fertilizer; 299 cm irrigation depth for surface irrigation and 144 for drip.

than 50% RDF, however, they were on par with 75% RDF (Table 2). The acidity decreased significantly with increased fertilizer dose and it was maximum under 50% RDF.

#### **Economic analysis**

The net returns due to planting system were significant and were maximum in normal planting (Rs 110,281) compared with paired planting system (Rs 94,139). The net returns were significantly higher under straight fertilizer with N through drip (Rs 118,370/ha) than WSF (Rs 86,050/ha). Though the fruit yield was increased about 2.46 tonnes/ha due to water-soluble fertilizer, its additional cost indicating economic infeasibility when compared with N through drip alone in medium deep soil. The application of recommended dose of fertilizer through drip registered significantly maximum net returns over rest of fertilizer levels. The benefit : cost were also higher under normal planting, in straight fertilizer and application of 100% RDF (Table 2).

#### **REFERENCES**

- Berad, S.M. 1996. 'Use of liquid fertilizer through drip irrigation of Banana (Cv. Basari).' M. Sc. (Agriculture), Thesis, Mahatma Phule Krishi Vidyapath, Rahuri, Maharashtra.
- Daniel, J. W., Fawell, P. J. and Champbell, S. J. 1985. The response of banana to plant spacing in double rows in North Queensland. *Queensland Journal of Agricultural and Animal Sciences* 42 (1) : 45-51.
- Hegde, D.M. and Shrinivas, K. 1990. Growth, productivity and water use of banana under drip and basin irrigation in relation to evaporation replenishment. *Indian Journal of Agronomy* 35 (1, 2) : 100-102.
- Kumar, A. and Singh, A.K. 2002. Improving nutrient and water use efficiency through fertigation. *Journal of Water Management* 10 (1,2) : 42-48.
- Parikh, M. M., Shrivastava, P.K., Savani, N. G., Holar, G. H. and Raman, S. 1993. Response of Banana to N application through fertilizer (In) *Proceedings of Workshop on Intergrated Development of Irrigated Agriculture*, held at New Delhi, pp. 524-531.
- Singh, U. R., Khan, A. and Singh, G. 1977. Effect of NPK fertilization on growth, yield and quality of banana Cv. Basarai. *Punjab Horticulture Journal* 17 (1, 2) : 64-69.