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Effect of hand removal and organic spray on maturity, yield, quality and economics of banana (*Musa paradisiaca*) cv. Grand Naine

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ABSTRACT

The study was carried out during 2021–22 at Navsari Agricultural University, Navsari, Gujarat, to investigate the effect of hand removal and organic sprays on banana maturity, yield and quality to improve productivity and income for growers. The experiment was laid out using a factorial completely randomised design (F-CRD) with three levels of lower hand removal and seven types of organic sprays, forming twenty-one treatment combinations with three replications in banana (*Musa paradisiaca*). After full bunch emergence, distal hands along with the male bud were removed, followed by sprays at 15 and 30 days after bunch emergence. The results revealed that removal of three hands (H_3) significantly promoted early maturity (82.10 days), highest third-hand weight (3.08 kg), finger length (24.45 cm), finger girth (11.00 cm), TSS (18.51°Brix), reducing sugar (6.62%) and total sugar (14.58%). In contrast, removal of one hand (H_1) recorded the greatest bunch weight (33.64 kg), bunch length (94.18 cm) and yield (116.80 t/ha). Among organic sprays, 5% *Gliricidia* leaf extract (O_5) recorded early maturity (80.22 days), maximum bunch weight (37.50 kg), bunch girth (116.28 cm), third-hand weight (3.40 kg), finger length (24.63 cm), finger girth (11.42 cm), yield (130.20 t/ha), reducing sugar (6.84%) and total sugar (14.93%). In interaction, removal of three hands and *Gliricidia* leaf extract 5% (H_3O_5) showed early maturity (76.67 days), maximum third-hand weight (3.50 kg) and finger length (26.03 cm). Whereas, removal of one hand and *Gliricidia* leaf extract 5% (H_1O_5) gave maximum bunch weight (43.63 kg), yield (151.49 t/ha), net return (₹16,13,170/ha) and BCR (4.53). Thus, removal of one hand and spray of *Gliricidia* leaf extract 5% at 15 and 30 days gave the highest yield and net return in banana.

Keywords: Banana, *Gliricidia* leaf extract, Hand removal, Net return, Organic spray

Banana (*Musa paradisiaca*) is one of the most produced fruit crops in the world, serving as a staple food for millions and providing a valuable source of income through both local and international trade. To meet the increasing market demand, it is crucial to enhance production without compromising edible qualities. Practices such as foliar application of plant growth regulators, organic sprays, chemicals and bunch management treatments have been commonly used to improve the growth, maturity, yield and quality of banana fruits. Bunch management techniques like nutrient spray, PGR spray, hand thinning, finger thinning, bunch sleeving and denavelling are among the most effective methods. Among these, hand removal and organic sprays on the bunch have proven to be particularly effective in enhancing bunch quality.

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Hand removal, an important intercultural operation, involves removing one or two distal hands from banana bunch soon after fruit setting. This helps increase the length and size of fingers on the remaining hands, improving the market value of the fruit. Typically, fingers of the distal hand are 30–40% smaller than those on the proximal hand due to developmental differences and competition for assimilates (Jullien *et al.* 2001a). As a result, distal hand fruits are often sold as lower-quality produce, reducing farmers' income. By removing terminal hands, dry matter is redistributed to the remaining hands, thereby increasing finger size (Jullien *et al.* 2001b). Boncato (1967) also reported a significant increase in bunch weight due to bunch trimming.

Long-term studies indicated that balanced use of NPK fertilisers alone could not sustain high yields over time due to secondary macro and micronutrient deficiencies and soil degradation. In response to consumer demand for safer, higher-quality food, there has been an increasing trend toward organic banana production, particularly in export markets where better returns are expected (Ouda and Mahadeen 2008). Therefore, this study was carried out to investigate the effect of hand removal and organic sprays on banana maturity, yield and quality at Navsari, Gujarat. The

development of such bunch management practices aimed to improve productivity and income for growers.

MATERIALS AND METHODS

Experimental site: The experiment was conducted from September to July of 2021–2022 at the Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari (20º57' N, 72º54' E; at an elevation of 11.89 m amsl), Gujarat. This area has a tropical climate, with warm, humid monsoons that bring a lot of rain, mildly cold winters, and hot-humid summers. The experimental field's soil texture was deep, clayey, and moderately drained, with a 42–50% clay concentration. With an EC of 0.35–0.45 dS/m and a *p*H of 7.6–8.0, the soil fertility was low in available N and high in accessible P and K.

Experimental design and field management: The experiment was laid out using a factorial completely randomised design (F-CRD) consisting of three levels of lower hand removal, viz. Removal of one hand (H_1), Removal of two hands (H_2) and Removal of three hands (H_3), and seven types of organic spray, viz. Water spray (O_1), 5% Cow urine (O_2), 5% *Jeevamrut* (O_3), 3% *Panchagavya* (O_4), 5% *Gliricidia* leaf extract (O_5), 3% Novel Organic Liquid Nutrients (O_6) and 3% Sea weed extract (O_7), comprising twenty-one treatment combinations with three replications.

At a spacing of 2.4 m × 1.2 m, tissue culture plants were planted in a 30 cm deep trench that had been created. At the time of planting, 10 kg/plant of fine-textured, well-decomposed farm yard manure was added. Planting was carried out in the second week of September during the year 2021. After two months of planting, each plant was fed with 300 g N, 90 g P_2O_5 and 200 g K_2O in six equal split doses at 15 days interval.

Treatments were imposed after full emergence of bunch. Hand removal was carried out on bunches having 13 hands i.e. hands at the distal end of the bunch were excised along with male bud, then organic sprays were applied after 15 and 30 days of bunch emergence as per treatments.

Cow urine was collected from Livestock Research Station, Kamdhenu University, Navsari, Gujarat. *Jeevamrut*, *panchagavya* and *Gliricidia* leaf extract (*Gliricidia sepium*) were collected from Organic Farming Unit, Navsari Agricultural University, Navsari, Gujarat. Banana pseudostem based Novel Organic Liquid Nutrients was collected from Banana Pseudostem Processing Unit, Soil and Water Management Research Unit, Navsari Agricultural University, Navsari, Gujarat. Sea weed extract was collected from local market of Navsari, Gujarat. To prepare the necessary spray strength, water was added to the concentrated organic solution. For each spray solution, 1 mL/L of spray adjuvant was added. Then spraying was done on all the sides of bunch by using manual sprayer. Bunches with lighter green colour and perfectly filled fingers were harvested for taking observations.

Data collection: Data on maturity period from the day of hand removal to harvesting (days); yield parameters, viz. bunch weight (kg), length of bunch (cm), girth of bunch (cm), weight of third hand (kg), number of fingers in third hand, finger length (cm), finger girth (cm) and fruit yield (t/ha); quality parameters, viz. pulp:peel ratio, TSS (°Brix), titrable acidity (%), ascorbic acid content (mg/100 g of pulp), reducing sugar (%), non-reducing sugar (%), total sugar (%) and shelf life (days) were recorded from four plants, from each repetition for all the treatments. The economics of all twenty-one treatment combinations were calculated based on prevailing prices of inputs and output and stated in terms of net returns per hectare to determine their economic feasibility.

Bunch weight, weight of third hand, pulp and peel weight to estimate pulp:peel ratio were recorded using electronic balance. Length of bunch, girth of bunch, finger length and finger girth were measured by using measuring tape. Fruit yield or output per hectare was estimated by multiplying mean bunch weight of individual treatment with total number of plants per hectare. A digital refractometer was used to record the TSS of the ripened fruit. The method described by Ranganna (1986) was used to estimate titrable acidity, ascorbic acid content, reducing and total sugar content. By deducting the value of reducing sugars from the total sugars, the value of non-reducing sugar was determined. Shelf life was noted as the number of days taken from harvesting to optimum edible stage, by keeping the fruits under ambient conditions.

Statistical analysis: For this investigation, Panse and Sukhatme's (1985) description of the completely randomised design using factorial concept was used, along with the standard way of analysis of variance approach. Based on the null hypothesis, the treatment differences were examined using the "F" test of significance. To compare two treatment means, the relevant standard error of mean (SEM±) was determined for each case, and the critical differences (CD) at the 5% level of probability were calculated. The treatment effects were determined to be significant under the "F" test. To comprehend the nature of variability in the experimental unit, the coefficient of variation (CV%) was also calculated for all the cases.

RESULTS AND DISCUSSION

Effect of hand removal: The presented data (Table 1) revealed that minimum days (82.10) taken for harvesting of bunch from the day of hand removal was noticed in treatment H_3 (removal of last 3 hands). The probable reason is that there is a positive correlation exists between number of hands/bunch and time required for maturity (Digal 2016). And this advance in maturity might be due to an increased rate of cell filling resulting from hand removal, as reported by Sarkar (2015). This outcome was in accordance with the results of several studies on banana (Sarkar 2015, Digal 2016, El-Kholy 2017, Aly *et al.* 2018).

The results presented (Table 1) clearly indicated that maximum bunch weight (33.64 kg), bunch length (94.18 cm) and maximum fruit yield (116.80 t/ha) were found under H_1 (removal of last hand) which were at par with H_2 (removal

Table 1 Effect of hand removal and organic spray on maturity and yield of banana cv. Grand Naine

Treatments	Maturity period (days)	Bunch weight (kg)	Length of bunch (cm)	Girth of bunch (cm)	Weight of third hand (kg)	Number of fingers in third hand	Finger length (cm)	Finger girth (cm)	Fruit yield (t/ha)
				Hand removal (H)					
H_1	89.71	33.64	94.18	104.79	2.71	20.29	22.16	10.46	116.80
H_2	86.67	32.50	92.40	109.39	2.98	20.76	23.89	10.76	112.83
H_3	82.10	30.01	87.49	112.02	3.08	20.38	24.45	11.00	104.21
SEM±	0.76	0.45	1.13	2.05	0.04	0.40	0.21	0.14	1.56
CD (*p*=0.05)	2.17	1.29	3.23	NS	0.11	NS	0.60	0.38	4.46
				Organic spray (O)					
O_1	89.78	27.16	85.76	98.82	2.42	20.22	22.40	10.39	94.30
O_2	88.11	29.18	91.26	102.98	2.69	20.11	23.23	10.58	101.31
O_3	87.22	30.53	91.71	104.94	2.82	20.22	23.40	10.61	105.99
O_4	86.11	31.76	91.84	107.02	2.92	20.44	23.54	10.64	110.26
O_5	80.22	37.50	93.76	116.28	3.40	20.78	24.63	11.42	130.20
O_6	85.78	34.71	93.04	115.38	3.16	20.89	23.68	10.78	120.52
O_7	85.89	33.52	92.14	115.72	3.04	20.67	23.62	10.74	116.39
SEM±	1.16	0.69	1.73	3.13	0.06	0.60	0.32	0.21	2.39
CD (*p*=0.05)	3.31	1.96	NS	8.93	0.16	NS	0.92	0.59	6.82
				Interaction (H × O)					
SEM±	2.01	1.19	2.99	5.41	0.10	1.04	0.56	0.36	4.13
CD (*p*=0.05)	5.74	3.40	NS	NS	0.28	NS	1.59	NS	11.81
CV%	4.03	6.43	5.67	8.62	5.80	8.83	4.09	5.75	6.43

Treatment details are given under Materials and Methods.

of last 2 hands), which might be due to higher number of hands/bunch (Digal 2016) in H_1 and H_2 compared to H_3. The similar results were obtained with studies in banana (Digal 2016), apricot (Rab *et al.* 2012) and guava (Rahman *et al.* 2017, Mishra *et al.* 2020).

The recorded data (Table 1) also revealed that maximum weight of third hand (3.08 kg) was noted in H_3 (removal of last 3 hands), which was at par with H_2. The outcome may be due to a decrease in sink size, leading to the redistribution of photoassimilates to the remaining hands, as reflected in the higher average hand weight (Donato *et al.* 2020). The results of the present study were also supported by similar studies in banana (Aly *et al.* 2018, Donato *et al.* 2020).

Further, it is evident from the data (Table 1) that maximum length (24.45 cm) and girth (11.00 cm) of fruit were observed in removal of last 3 hands from bunch (H_3) which were statistically at par with H_2. It may be due to higher accumulation of assimilates in comparison to H_1 treatment. Due to reducing the number of hands, more food material is diverted to the fingers which might have helped to increase length and girth of fruit (Digal 2016). The results were also found similar with several studies in banana (Donato *et al.* 2020, Jayale 2020) and guava (Rahman *et al.* 2017, Mishra *et al.* 2020).

In addition, maximum TSS (18.51°Brix), reducing sugar (6.62%) and total sugar content (14.58%) in banana fruit were recorded under H_3 (removal of last 3 hands) and stood at par with H_2 treatment (Table 2). This improvement in TSS, reducing sugar and total sugar could be attributed to the thinning of the hand, which reduced the number of fruits in the bunch. This likely increased the leaf-to-fruit ratio, facilitating greater synthesis, transport and accumulation of sugars in the remaining fruits (Mishra *et al.* 2020). The results were also similar to previous studies in apricot (Rab *et al.* 2012), banana (Sarkar 2015, Aly *et al.* 2018, Jayale 2020), and guava (Rahman *et al.* 2017, Mishra *et al.* 2020).

Effect of organic spray: Among all organic spray, *Gliricidia* leaf extract 5% (O_5) recorded an early maturity (80.22) of bunch from the day of hand removal (Table 1). This might be due to effect of higher amount of N, Mg and K content of the *Gliricidia* leaf extract on banana bunch (Aye and Adegun 2013, Wanjira and Muriuki 2019). In studies on post-shoot nutrient sprays, the reduction in the time from flowering to harvesting is due to enhanced growth rates and increased biomass accumulation in the fruit, driven by the additional nutrient supply. This process is further supported by the efficient translocation of assimilates from source to sink, facilitated by N, Mg, and K. Potassium,

Table 2 Effect of hand removal and organic spray on quality of banana cv. Grand Naine

Treatments	Pulp : peel ratio	TSS	Titrable acidity (%)	Ascorbic acid content (mg/100 g of pulp)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Shelf-life (days)
				Hand removal (H)				
H_1	2.37	17.80	0.32	5.59	6.31	7.66	13.97	10.81
H_2	2.43	18.17	0.31	5.67	6.49	7.81	14.30	11.24
H_3	2.45	18.51	0.30	5.74	6.62	7.97	14.58	11.52
SEM±	0.03	0.19	0.01	0.06	0.06	0.12	0.12	0.21
CD (p=0.05)	NS	0.55	NS	NS	0.16	NS	0.34	NS
				Organic spray (O)				
O_1	2.33	17.53	0.32	5.41	5.97	7.52	13.49	10.44
O_2	2.37	18.02	0.32	5.63	6.14	7.47	13.61	10.67
O_3	2.39	18.16	0.31	5.66	6.55	7.73	14.28	11.22
O_4	2.42	18.30	0.31	5.70	6.58	7.75	14.33	11.33
O_5	2.48	18.41	0.30	5.80	6.84	8.10	14.93	11.67
O_6	2.47	18.33	0.31	5.72	6.61	8.03	14.64	11.44
O_7	2.45	18.38	0.30	5.75	6.63	8.07	14.70	11.56
SEM±	0.04	0.30	0.01	0.09	0.09	0.18	0.18	0.31
CD (p=0.05)	NS	NS	NS	NS	0.25	NS	0.52	NS
				Interaction (H × O)				
SEM±	0.07	0.51	0.01	0.15	0.15	0.32	0.31	0.54
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV%	5.00	4.87	6.71	4.53	3.98	7.06	3.79	8.43

Treatment details are given under Materials and Methods.

in particular, acts as a key metabolic activator, enhancing respiration and photosynthesis rates. As a result, the foliar or bunch application of potassium accelerates the transition from flowering to harvest. This aligns with the findings of Kumar *et al.* (2011), who highlighted the role of potassium in promoting earlier maturity through improved metabolic activity.

Similarly, maximum bunch weight (37.50 kg), bunch girth (116.28 cm), weight of third hand (3.40 kg), finger length (24.63 cm), finger girth (11.42 cm) and fruit yield (130.20 t/ha) were noted in O_5 (*Gliricidia* leaf extract 5%). When compared with the control i.e. water spray (94.30 t/ha), the best treatment O_5 (130.20 t/ha) recorded a 38.1% increase in yield. Which might be due to effect of higher amount of nutrients (N, K and C:N ratio) and plant growth promoting substances present in the extract (Harsha 2022) on banana bunch. Maximum reducing sugar (6.84%) and total sugar (14.93%) of fruit was recorded with O_5 (*Gliricidia* leaf extract 5%). This improvement in quality might be due to the effect of higher amount of K and micronutrients present in *Gliricidia* leaf extract (Alakhyar *et al.* 2019).

Interaction effect: The findings (Table 3) clearly showed that early bunch maturity (76.67 days), maximum weight of third hand (3.50 kg) and finger length (26.03 cm) were recorded in treatment combination of removal of three hands and *Gliricidia* leaf extract 5% (H_3O_5) (Fig. 1). Whereas, maximum bunch weight (43.63 kg) and fruit yield (151.49 t/ha) were produced in treatment combination

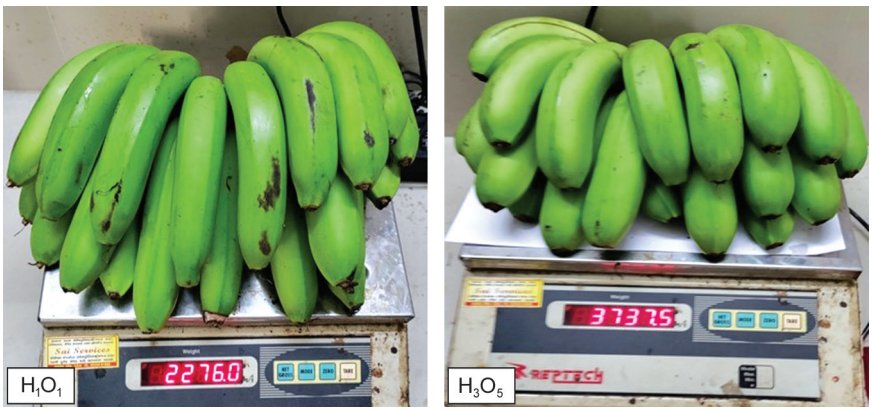

Fig. 1 Best treatment (H_3O_5) compared to control (H_1O_1) with respect to weight of third hand (kg) of banana.

Table 3 Interaction effect between hand removal and organic spray on maturity and yield of banana cv. Grand Naine

Treatment combinations	Maturity period (days)	Bunch weight (kg)	Weight of third hand (kg)	Finger length (cm)	Fruit yield (kg/ha)
H_1O_1	93.00	27.77	2.39	21.80	96.42
H_2O_1	88.33	27.74	2.41	22.60	96.30
H_3O_1	88.00	25.97	2.46	22.80	90.18
H_1O_2	88.67	29.79	2.61	22.73	103.44
H_2O_2	87.67	29.87	2.62	23.13	103.70
H_3O_2	88.00	27.88	2.83	23.83	96.79
H_1O_3	90.33	31.31	2.50	22.30	108.70
H_2O_3	85.67	31.51	2.87	23.43	109.39
H_3O_3	85.67	28.77	3.08	24.47	99.88
H_1O_4	91.33	32.33	2.62	22.43	112.24
H_2O_4	88.00	32.95	3.02	24.27	114.39
H_3O_4	79.00	30.00	3.13	23.93	104.16
H_1O_5	81.67	43.63	3.25	21.87	151.49
H_2O_5	82.33	35.62	3.45	26.00	123.66
H_3O_5	76.67	33.25	3.50	26.03	115.43
H_1O_6	91.33	36.50	3.02	21.87	126.73
H_2O_6	87.00	35.18	3.20	24.47	122.15
H_3O_6	79.00	32.46	3.27	24.70	112.69
H_1O_7	91.67	34.16	2.58	22.13	118.60
H_2O_7	87.67	34.63	3.27	23.33	120.24
H_3O_7	78.33	31.78	3.28	25.40	110.33
SEM±	2.01	1.19	0.10	0.56	4.13
CD (p=0.05)	5.74	3.40	0.28	1.59	11.81
CV%	4.03	6.43	5.80	4.09	6.43

Treatment details are given under Materials and Methods.

(H_1O_5) (removal of last hand and *Gliricidia* leaf extract 5%) (Fig. 2).

Economics: The highest net return (₹/ha 16,13,170) and maximum BCR (4.53) were generated in the treatment combination H_1O_5 (removal of last hand + *Gliricidia* leaf extract 5%) (Table 4). This was due to lower cost of organic spray and higher yield of banana due to combined effect of treatments.

Table 4 Economics of different treatment combinations as influenced by hand removal and organic spray on banana cv. Grand Naine

Treatment combinations	Total cost (₹/ha)	Gross income (₹/ha)	Net return (₹/ha)	BCR
H_1O_1	3,55,570	12,53,460	8,97,890	2.53
H_2O_1	3,55,570	12,51,900	8,96,330	2.52
H_3O_1	3,55,570	11,72,340	8,16,770	2.30
H_1O_2	3,55,990	13,44,720	9,88,730	2.78
H_2O_2	3,55,990	13,48,100	9,92,110	2.79
H_3O_2	3,55,990	12,58,270	9,02,280	2.53
H_1O_3	3,56,200	14,13,100	10,56,900	2.97
H_2O_3	3,56,200	14,22,070	10,65,870	2.99
H_3O_3	3,56,200	12,98,440	9,42,240	2.65
H_1O_4	3,59,350	14,59,120	10,99,770	3.06
H_2O_4	3,59,350	14,87,070	11,27,720	3.14
H_3O_4	3,59,350	13,54,080	9,94,730	2.77
H_1O_5	3,56,200	19,69,370	16,13,170	4.53
H_2O_5	3,56,200	16,07,580	12,51,380	3.51
H_3O_5	3,56,200	15,00,590	11,44,390	3.21
H_1O_6	3,74,470	16,47,490	12,73,020	3.40
H_2O_6	3,74,470	15,87,950	12,13,480	3.24
H_3O_6	3,74,470	14,64,970	10,90,500	2.91
H_1O_7	5,21,890	15,41,800	10,19,910	1.95
H_2O_7	5,21,890	15,63,120	10,41,230	2.00
H_3O_7	5,21,890	14,34,290	9,12,400	1.75

Selling price of banana @13 ₹/kg.
Treatment details are given under Materials and Methods.

Fig. 2 Best treatment (H_1O_5) compared to control (H_3O_1) with respect to bunch weight (kg) of banana.

Results of the experiment indicated that after full emergence of bunch, removal of last hand and organic spray of *Gliricidia* leaf extract 5% at 15 and 30 days gave the highest yield and net return in banana cultivation.

REFERENCES

Alakhyar Fahrurrozi F A, Widodo W and Sari D N. 2019. Use of *Gliricidia*-enriched liquid organic fertiliser for production of caisim (*Brassica juncea* L.). *Journal Agroqua* **17**(1): 1–7.

Aly M A M, Ezz T M, Ibrahim E G and Mohamed A R. 2018. Improvement of yield and quality of banana (*Musa* spp.) Grand "Nain" cv. through bunch coverage colour and trimming. *Journal of Advances in Agricultural Researches* **23**(2): 218–29.

Aye P A and Adegun M K. 2013. Chemical composition and some functional properties of moringa, leucaena and *Gliricidia* leaf meals. *Agriculture and Biology Journal of North America* **4**(1): 71–77.

Boncato A A. 1967. Effects of reducing the number of hands in a bunch of Lacatan banana. *Philippines Journal of Plant Industry* **32**: 243–51.

Digal J R. 2016. 'Effect of bunch management and chemical treatments on maturity, yield and quality of banana (*Musa paradisiaca* L.) cv. Grand Naine'. MSc Thesis, Navsari Agricultural University, Navsari, Gujarat, India.

Donato S L R, Santos M R D, Arantes A D M and Ramos A V. 2020. 'Prata-Ana' banana under irrigation levels, planting densities and bunch trimming. *Revista Brasileira de Fruticultura* **42**(5): 1–13.

El-Kholy M F A. 2017. Spraying seaweed extract and hand trimming to improve yield and fruit quality of Grand Nain banana plants. *Journal of Plant Production* **8**(11): 1199–1204.

Harsha S K. 2022. 'Standardisation of *Gliricidia* based formulation as a liquid organic nutrient'. MSc Thesis, Navsari Agricultural University, Navsari, Gujarat, India.

Jayale S S. 2020. 'Effect of dehanding and bunch covering on yield and quality of banana'. MSc Thesis, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India.

Jullien A, Malezieux E, Michaux-Ferriere N, Chillet M and Ney B. 2001a. Within-bunch variability in banana fruit weight: Importance of developmental lag between fruits. *Annals Botany* **87**: 101–08.

Jullien A, Munier-Jolain N G, Michaux-Ferriere N, Chillet M and Ney B. 2001b. Effect of pulp cell number and assimilate availability on dry matter accumulation rate in a banana fruit [*Musa* spp. AAA group 'Grande Naine' (Cavendish sub group)]. *Annals Botany* **88**(2): 321–30.

Kumar C P N, Sathyanarayana B N, Naresh P and Lakshmipathy M. 2011. Effect of certain pre harvest treatments in improving the yield and quality of banana cv. Nanjangudu Rasabale. *Plant Archives* **11**(2): 677–81.

Mishra M, Lal S and Kumar R. 2020. Effect of fruit thinning on growth and quality of rainy season crop of guava (*Psidium guajava* L.). *Journal of Pharmacognosy and Phytochemistry* **9**(5): 3214–17.

Ouda B A and Mahadeen A Y. 2008. Effect of fertilisers on growth, yield, yield components, quality and certain nutrient contents in broccoli (*Brassica oleracea*). *International Journal of Agriculture and Biology* **10**(6): 627–32.

Panse V G and Sukhatme P V. 1985. *Statistical Methods for Agricultural Workers*, pp. 152–61. Indian Council of Agricultural Rresearch, New Delhi.

Rab A, Rahman J, Abdiani S, Qadim A, Khattak M K and Nawab K. 2012. Thinning intensity affects the yield and fruit quality of apricot cv. Trevett. *Pakistan Journal of Botany* **44**(3): 887–90.

Rahman H, Akter A, Rahman J, Riad M I and Rahman M M. 2017. Effect of fruit thinning and bagging on the yield and quality of guava. *Journal of Agricultural Science and Technology* **6**(1): 20–27.

Ranganna S. 1986. *Manual of Analysis of Fruits and Vegetables Products*, pp. 7–12. Tata McGrew Hill Publishing Company Limited, New Delhi.

Sarkar S. 2015. Dehanding in improving fruit quality of banana. *International Journal of Bio-resource and Stress Management* **6**(2): 198–201.

Wanjira E O and Muriuki J. 2019. Gliricidia Sepium *Fact Sheet: Establishment, Management and Benefits*. World Agroforestry (ICRAF), Nairobi.