

Hand pollination for improving productivity and quality of watermelon

Hand pollination is promising in the places where inadequate population of pollinators and scarce water availability for irrigation are experienced. It can improve the socio-economic conditions of the farmers by taking care of the yield. Inadequate pollination is one of the main reasons for the low productivity of many fruit and nut crops. Given the central role of pollination in orchard productivity, pollination management must become as important as other horticultural practices if economic returns and agricultural competitiveness is to be enhanced. Hand pollination gives better yield, promotes rural employability and thus provides livelihood security to marginal farmers.

THE southern part of India undergoes a scorching and humid climate. Tamil Nadu, a coastal state in south India, is prone to droughts. With many cities like Chennai expanding at very fast pace and remaking of cities into smart cities is on headway, watermelon production has come down considerably for two main reasons. One is the decreasing farm areas which produce watermelon and the other is the decreasing production of watermelon mainly due to decreased presence of pollinators such as bees on account of the environmental impact of urbanization, heat and pollution. It is a well-known fact that for pollen tube development, pollination is a prerequisite. Pollination leads to fertilization of ovules resulting in seed and fruit setting in flowering plants and insect pollinators play a very crucial role in the entire process. It is claimed by the scientific evidence that pollination certainly improves the yield and quality of crops, such as fruits, vegetables, seeds, spices, oilseeds and forage crops. Although the roles of insect pollinators are very important, they are negatively impacted by different factors. Climate change is a major issue which is negatively harming the insect pollinators. Biotic stress accompanied with climate change may cause further a decline of insect population and lead farmers and researchers to look for alternative pollinators. Well-known pollinators to replace honey bees as reported in various studies include the alfalfa leaf-cutter bee (*Megachile rotundata*) and alkali bee (*Nomia melanderi*) in alfalfa pollination, mason bees (*Osmia* spp.) for pollination of orchards.

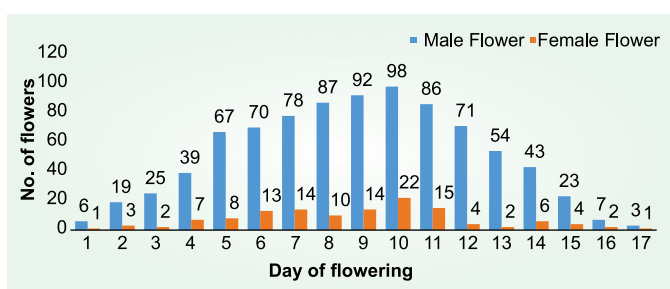
Citrus, banana, some figs, and most fruit trees require an efficient pollination to produce an optimal amount and quality of fruits. Given the central role of pollination in orchard productivity, pollination management must become as important as other horticultural practices if economic returns and agricultural competitiveness is to be enhanced. With the above background this experiment emerged with the central question; can hand pollination

improve the socio-economic conditions of the farmers by taking care of the yield? To answer the above question, the yield, uniformity in size, shape, quality, quantity and profit comparing the yield of artificial pollination with natural pollination using organic and conventional methods were studied.

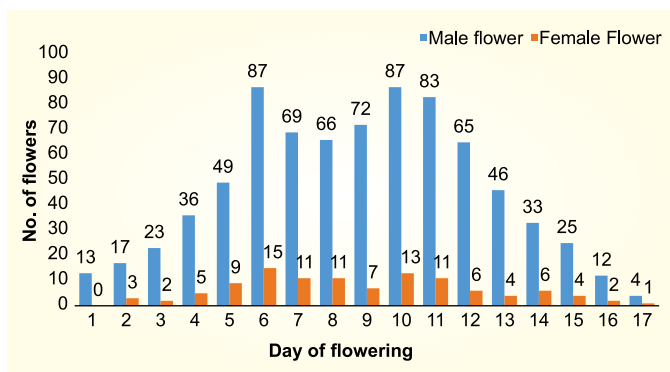
The experimental study was performed in the were Field Laboratory of Centre for Water Resources, College of Engineering Guindy, Anna University, Chennai, India. The experiment was conducted in 15 m × 15 m field. The field was divided into four equal parts. In Plot I, Natural pollination in Organic farming; Plot II, Natural pollination in Conventional farming; Plot III, Artificial pollination in Organic farming and in Plot IV, Artificial pollination in Conventional farming method. In each plot, four pits were dug of spacing 2.5m × 2.5m. There were two plants and two drippers in each pit. Soil texture testing using International pipette method showed sand=64.3%, Silt=17.5%, and clay=18.2% and the soil is sandy loam. Soil was slightly acidic. Digging four pits (45×45×45 cm) at a spacing of 2.5 ×2.5 m and filled with sandy loam soil. For organic farming, pit NPK mixer was applied at approximately 300 g/pit. For conventional method, *N-Nitrogen; P- Phosphorous; K-Potassium complex (NPK19:19:19)* (10.65 g/pit) and urea (4.40 g/pit) was applied. Thereafter, drip installation was done. For germination of seeds, initially 6 seeds were sown in each pit, the seeds were dipped at 2.5 cm depth. Water supply was done by hand sprinkling. Following that thinning of plants was done after 17 days of sowing. Only two healthy plants were allowed to grow in each pit. As next step, organic pesticide – 2 ml of Vinci Bio was mixed with 2 g of *Acephate* powder in 1 litre water and sprayed uniformly throughout the leaf area and Inorganic Pesticides 1.15 ml of *Monocrotophos* was mixed with 2 g of turf powder in 1 litre of water and sprayed on leaf area. Hand pollination for melons with the male flower starts with carefully removing a male

flower from the plant. Strip away the petals so that the stamen is left. Carefully insert the stamen into an open female flower and gently rub the stamen on the stigma (the sticky knob). Try to evenly coat the stigma with pollen. One stripped male flower several times on other female flowers. As long as there is pollen left on the stamen, hand pollination on other female melon flowers can be done. After pollinating artificially, the female flower should be covered with a polythene cover to avoid cross pollination. When the petals are closed, the polythene cover can be removed. Hand pollination started on 28th day of the sowing. The first harvest is done between 50 & 60th day, the second harvest is done between 61th and 70th day and the third harvest between 71th and 80th day.

The number of male and female flowers in organic method of cultivation was higher compared to conventional method of cultivation.

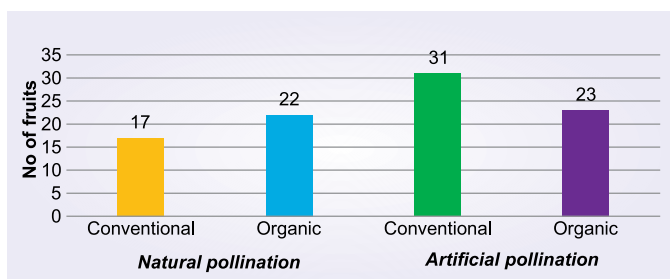


Number of flowers in conventional method



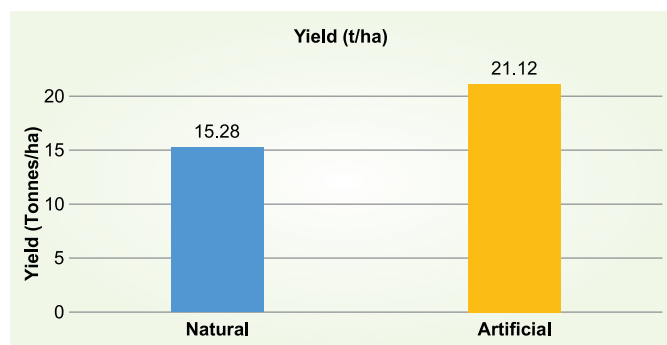
Number of flowers in organic method

Out of 18 days of flowering, the number of male and female flowers increased for the first 10 days and then started decreasing. The comparison of number of fruits set in hand pollination and natural pollination for different type of farming is shown in the graph.



Number of fruits harvested

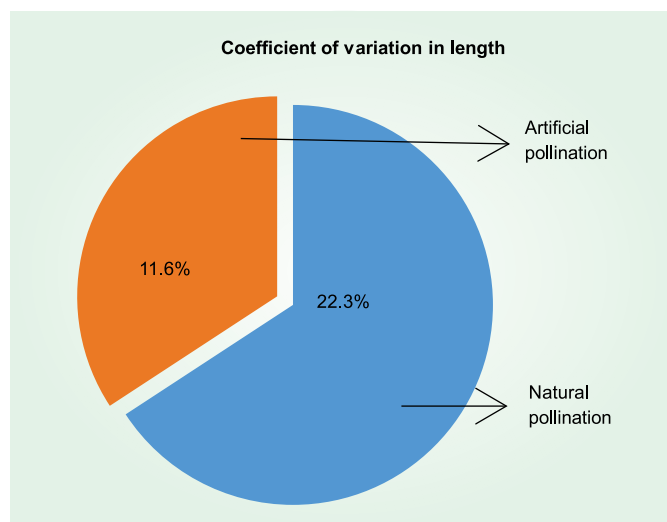
Hand pollination with the conventional farming out performed hand pollination with organic farming, natural pollination with organic farming and natural pollination with conventional farming, respectively. In artificial pollination, all the flowers are pollinated within a small period, at favourable condition (early morning), which increases the chance of fruit formation. While in natural pollination, the flowers have to wait for the visit of bees or other pollinators leading to non-occurrence of pollination within favorable period of time.



Yield of fruits

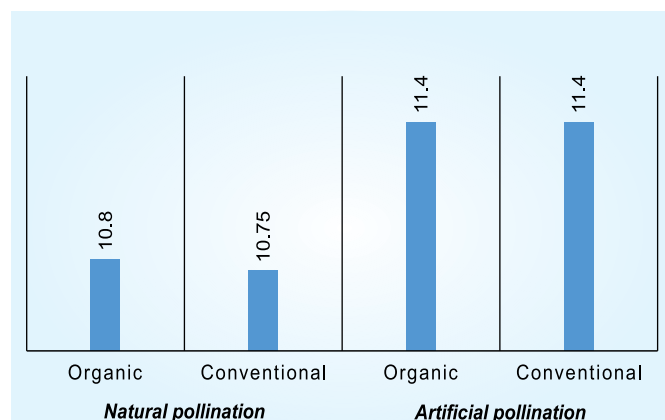
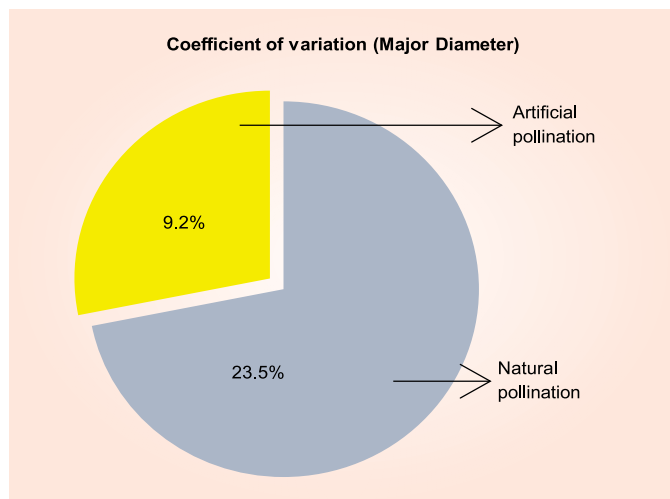
There is a possibility of harvesting an additional yield of 40% when compared to natural pollination. This is because of increase in number of fruits set as a result of hand pollination. The average weight of fruits harvested was 4.4 kg. Comparison of coefficient of variation in dimensions of fruits and quality of fruits was done. The size of the fruit in hand pollination was small compared to natural pollination; but the uniformity of shape and size in hand pollination was more preferable as compared to natural pollination.

The above conclusion is based on less coefficient of determination for hand pollination compared to natural pollination. This is because the development of fruits is uniform in case of artificial pollination, as the time of occurrence of fertilization in female flowers is same for all. With regard to quality of fruits, hand pollination produced better quality fruits as compared to natural pollination as indicated by Brix score.

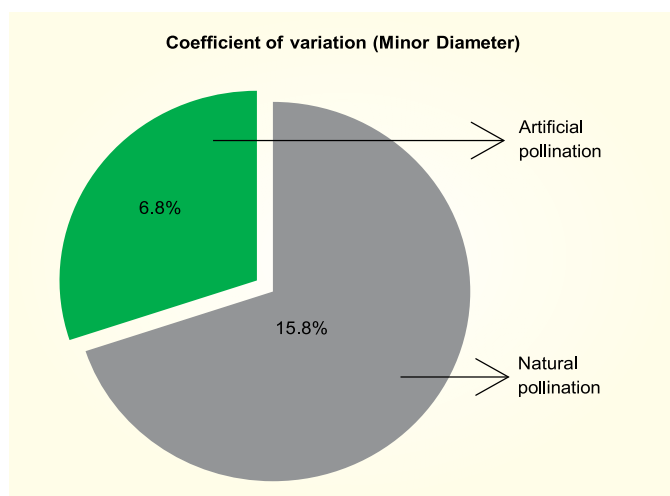


Artificial pollination vs. Natural pollination in watermelon

Pollination type	Farming type	No. of Fruits	Fruit weight / 112.05 Sq m	Yield (t/ha)	Farm rate price (₹ 5500/t)	Average cultivation cost (₹)	Gross profit (₹)	Coefficient of variation (%) in			Juice quality (Brix value %)
								L*	D1*	D2*	
Natural	Conventional	17	74.8	6.68	84040	32607.5	51433	22.3	23.5	15.8	10.8
Natural	Organic	22	96.8	8.60							10.75
Artificial	Conventional	31	136.4	12.12	116160	34647.5	81513	11.6	9.2	6.8	11.4
Artificial	Organic	23	1012	9.00							11.4



Brix value (%) of fruits



Coefficient of variation in dimensions of fruit

The gross profit for hand pollination is 59% higher than natural pollination, even including the extra cost spent on the labourers. The cost of selling of watermelon is ₹ 5500/t. There was a bumper increase in the yield of watermelons by 40% with comparatively better attributes. Moreover, the labour demanding hand pollination promotes rural employability and thus, can be used as a strategy to prevent migration of rural farmers to cities.

For further interaction please write to:

Soorya Vennila and K Ramesh, Anna University, Chennai, Tamil Nadu 600 025. *Corresponding author
E-mail: sooryavennila@gmail.com

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For assistance contact:

Business Manager

Directorate of Knowledge Management in Agriculture (DKMA)

Indian Council of Agricultural Research

Krishi Anusandhan Bhavan, Pusa, New Delhi 110 012

Telefax: 011-2584 3657; E-mail: bmicar@gmail.com