Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue [2] 2017: 354-360

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804
NAAS Rating 4.95

FULL LENGTH ARTICLE **OPEN ACCESS**

A Review Of Works Done Regarding Precision Farming In Banana

Utpal Das*, R.K.Bhattacharyya, Purnima Pathak
Assam Agricultural University, Jorhat 785 013, Assam, India
*Email ID: utpaldashorts14@gmail.com
**Corresponding author*

ABSTRACT

Precision farming the application of technologies and principles to manage spatial and temporal variability associated with all the aspects of agricultural production for improving crop performance and environmental qualities. In short it means adding the right amount of treatment at the right time and the right location within a field. The economic yield in any crop generally depends upon the cumulative effects of interaction among several factors such as genetic makeup of crop variety, climatic factor, mineral nutrition and cultural practices adopted. Banana is one of the cheapest, plentiful and most nourishing complete foods packed with all necessary and health giving elements. Banana is considered to be the fourth most important global food commodity after rice, wheat and milk in terms of the gross value of production and is of great socio-economic significance in India. Banana is more sensitive to moisture stress compared to other fruit crops.Banana is a heavy feeder of nutrients and as a mesophytic plant it requires high soil moisture for good growth and development leading to production of a heavy bunch. Drip fertigation results in high water use efficiency, uniformity of plant, reduced application cost for fertilizers, reduced labour demand, and reduced weed infestation, control erosion, reduced salinity hazards and more crop productivity per unit area. Of the varied components of precision farming systems comprising drip irrigation, fertigation, micronutrient foliar spray, bunch spray of sulphate of potash as well as black LDPE film. Combination of the entire precision faming component ishighly effective in improving the growth, yield and quality characters as well as benefit-cost ratio in banana.

Received 02.07.2017 Revised 02.08.2017 Accepted 21.08.2017

INTRODUCTION

With increasing population, urbanization and contagious depletion of natural resources, there has to be a paradigm shift in farmer's perception from production to productivity and to profitability. In this present scenario, the major challenge arising are shrinking land and depleting water and other related resources in agriculture. The concept of precision farming can help to know about optimum use of resources.

Botanically, banana is monoecious, monocotyledonous, monocarpic, mesophytic, perennial herb belonging to the family Musaceae.Water is one of the most important factors limiting production of banana crop. Banana is more sensitive to moisture stress than any other fruit crops. Banana requires sufficient soil moisture throughout its growth period. Lack of water can lead to declining plant health, lower yield and poor quality of fruits. In fact, every aspect of plant growth is affected by water stress. However, frequent water stress may upset the nutrient status of the plants, resulting in various nutrient deficiencies and metabolic disturbances. Irrigation is the only means to supply water to the crops during these critical stages. Among various methods of irrigation, drip irrigation is the best available technology for judicious use of water for growing horticultural crops in large scale on sustainable basis (Hasan and Sirohi, 2006).

Drip fertigation results in high water use efficiency, uniformity of plant, reduced application cost for fertilizers, reduced labor demand, reduced weed infestation, control erosion, reduced salinity hazards and more crop productivity per unit area and a well designed drip irrigation system practically does not allow water loss to runoff, deep percolation and evaporation.

Besides fertilizer, the micronutrients like copper (Cu), zinc (Zn), molybdenum (Mo), boron (B), and manganese (Mn) are also necessary for optimum vegetative growth, fruit yield and quality of banana (Srivastava, 1964).The post shooting application of Sulphate of Potash twice resulted in increase in bunch weight, finger weight, finger length, pulp weight and peel weight; pulp to peel ratio, total bunch yield and benefit: cost ratio (Mulagund*et al.*, 2015).

Mulching is practiced to reduce the evaporation component of the crop water requirement. During the earlier stages of crop growth period, evaporation is the major component, while under well developed canopy, transpiration is much higher than evaporation (>90%). Mulching plays a significant role in economic orcharding. Mulching of the tree basins is necessary to check weed growth, conserve soil moisture, higher soil temperature, fluctuation and activate the biological properties of soil.

Influence of different components precision farming on growth parameters of banana

Drip irrigation studies in banana cv. 'Barjahaji' under Assam condition resulted significantly higher pseudostem height and girth, leaf area index, leaf area, number of functional leaves both at large and shooting stage, over the basin method of irrigation and height value was under treatment with 75% evaporation replenishment. It was found that lowest value of phyllochron (9.42 days) and minimum days for shooting (442.42 days) under treatment with 75% PE. Among the plants under various levels of drip irrigation, the leaf RWC increases with increasing levels of evaporation replenishment. The highest leaf RWC (92.06%) was recorded in treatment with 125% evaporation replenishment at shooting (Salvin, 1999).

Khound (2007) reported that among different drip irrigation levels, drip irrigation at 0.75 EpR recorded the earliest shooting, shooting harvest interval and crop duration in banana cv. Barjahaji.

Tungoe (2011) reported that among different drip irrigation levels, drip irrigation at 0.75 ER recorded increased in pseudostem height and girth, total number of leaves leaf area, and LAI, leaf RWC and different quality parameters ware significantly increased by drip irrigation as well as fertilizer levels.

Chauhan*et al.* (2007) reported that fertigation with 75% of the recommended dose of fertilizer significantly increased the vegetative growth of Kiwi fruit over soil fertilization with a 25% saving of fertilizers.

The highest plant height was observed in fertigation treatment with 75% of recommended dose of fertilizer in Pomegranate cv. Ganesh as reported by Singh *et al.* (2006).

Bhattacharyya (1988) found that foliar application of micronutrients (Cu, Zn, Mn, B, Mo, Mg, Fe and Polymax super) in kew pineapple, significantly increased the plant height, number of leaves and leaf area, shoot root ratio and total dry matter production.

An investigation was carried out to study the effect of foliar application of micronutrients *viz.*, Zn, Fe and B singly or in combination on growth, yield and quality of banana cv. Martaman (AAB, Silk). Combined application of Fe (0.5%) and Zn (0.5%) showed the best response on plant growth in terms of plant height, basal girth of pseudostem, number of leaves produced per plant and minimum duration between emergences of two successive leaves. The micronutrient induced marked improvement in days to shooting, days to bunch harvest and total crop duration (Pathak*et al.,* 2011).

An experiment was conducted at the Horticulture farm of the Bangladesh Agricultural University to study the effect of micronutrient and their method of application on growth yield and quality of banana. Foliar application of micronutrients Zn+ B+ Cu @ 5+2+2 g per plant increase in plant height (163.15 cm), base girth (51.76 cm), number of leaves (32.23), maximum days to shooting (280.86 day) (Rashid, 2007).

Black polyethylene film as soil cover was found to increase trunk circumference, shoot length and number of bearing branches in pear and peaches (Rahovic and Petrovic, 1977).

Bhattacharyya and MadhavaRao (1988) reported that soil covers and soil moisture regime affect the leaf production and Root-cation Exchange Capacity (CEC) of 'Robusta' banana.

Influence of different components precision farming on yield characters of banana.

Raskar (2000) found that the yield of banana can be increased with application of 100% recommended dose of water soluble fertilizers.

Mathew (2003) reported that same level of yield can be obtained with drip irrigation like conventional irrigation with half dose of fertilizer.

Guerra *et al.* (2004) reported that monthly fertigation with 100% RDF gave higher bunch weight and higher yield as compared to side dressing fertilization in Prata-ana-banana.

Jains (2004) found that 25-30% increase in yield of banana by using fertigation and that distribution of nutrients is uniform.

Studies on drip irrigation were conducted on Muscat grapes at TNAU to find out the effect of water soluble fertilizer and normal fertilizer on yield and quality with various levels of drip and fertilizer levels and reported that 100% water replenishment with 125% water soluble fertilizer gave a better yield of 24.28 t/ha compared to 100% water replenishment with 125% normal fertilizer (Ashokaraja, 2005).

Studies conducted in the experimental orchards of All India Coordinated Research Project (TF), Dr. PDKV, Akola showed that highest yield and fruit weight was obtained in the 75% recommended dose of nitrogen and potassium through drip in case of acid lime as reported by Ghode and Joshi (2007) .

Bhattacharyya (1982) found that RWC content at shooting had correlation with bunch weight. Leaf RWC at shooting would, therefore serve as a good index of creation of strong and large sink to form a heavy bunch.

Holder and Gumbs (1983) reported that irrigation at every two days and depth equal to evapotranspiration produced the highest yield of banana.
Sanders *et al.* (1989) conducted drip irrigation studies in tomato at Carolina State University, Raleigh and found that the concentration of soluble solids, total solids and pH decreased with increasing trickle irrigation rates.
Hedge and Srinivas (1990) reported that drip irrigation based on evaporation replenishment gave significant higher dry matter production, bunch weight and yield compared with basin irrigation.
Working with Mineola mandarin, Dasberg*et al.* (1997) reported that low N rate 100 kg N/ ha caused a gradual decline in fruit yield and in leaf nitrogen content but produce larger fruit with thinner rind as compared with 200 and 300 kg N/ ha.
Yield performance of both Kesar and Totapuri mangoes has done well under fertigation and they have recorded a yield of 6 t/acre (Nagaranjan, 2001).
Mukesh (2001) that fertilization through drip with water soluble fertilizer increased the bunch weight and yield of grapes compared to that fertilization with normal fertilizer with conventional irrigation.
Reddy and Srinivasulu (2004) reported fertigation increase banana yield to 92.5 t/ha compared to drip irrigation and flooding with fertilizer pocketing with yielded 82-86 t/ha.
A field experiment for drip irrigation scheduling in mango based upon the pan evaporation replenishment rate was conducted. The long term experimental results revealed that significantly maximum canopy volume, fruit number and yield were recorded due to daily drip irrigation at 75% pan evaporation replenishment (Kumar *et al.,* 2008).
Effect of drip irrigation on the growth and yield of strawberries were studied inside a plastic greenhouse. The results showed that fruits, above-ground biomass, runners, total berry yields, marketable strawberry yields (>5 g), the size of strawberry fruits all increased when the amount of irrigation water increased from Ep 0.75, Ep 1.00 to Ep 1.25. Irrigated water increased strawberry yields not only by increasing the number of berries but also by increasing the mean weight of the berries (Yuan *et al.*, 2004).
Pathak*et al.* (2011) reported that application of Fe (0.5%) + Zn (0.5%) recorded maximum bunch weight (16.30 kg), hands (9.2 per bunch), fingers (129.2/bunch), yield (40.75 t/ha), finger length (14.80 cm), finger breadth (13.10 cm), days to ripening (8.1 days).
Rashid (2007) reported that foliar application of micronutrients increased number of finger per bunch (45.25), bunch weight of (4.98 kg) and the yield (12.46 t/ha).
Foliar sprays of zinc, zinc+ copper+ manganese, boron and zinc+ manganese+ copper+ iron+ boron produce more fruit in mandarin tree (Aiyappa*et al.*, 1968).
In 'Kew' pineapple foliar application of micronutrients *viz.*, Boron, zinc, molybdenum and their mixture and Tracel produced significant effect on fruit growth, circumference, and fruit weight with or without crown (Barua, 1984).
Bhattacharyya (1988) obtained an increased yield of pineapple with foliar application of micronutrient mixture consisting copper, zinc, boron, manganese, molybdenum, magnesium, iron and Polymax super.
Application of NPK and micronutrients separately or in various combinations had been reported to increase fruit production but reduce the sucker production (Figueroa Escobar, 1962).
Pant (1969) reported that in apple foliar application of B+ Cu+ Zn increased thesize of fruit.
Oganov and Talyboc (1973) reported that foliar application of the nutrient mixture 1% $(NH_4)_2$ SO_4+ 0.5% Urea+ 0.5% KNO_3+ 0.2% $MnSO_4$+ 0.1% $ZnSO_4$+ 0.2% H_3BO_3+ 0.05% Mo $(NH_4)_2$ had increased yield in grapes to 10-15%.
A field experiment on the effect of micronutrients on yield and fruit quality of banana cv. Basrai was carried out at Fruit Research Station, Navsari Agricultural University, Gandevi. Six treatment combinations of foliar spray and soil application of micronutrients *viz.*, Fe and Zn with control were tried. The foliar application of $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%) was found to be the best treatment for bunch weight (23.85 kg), bunch length (93.50 cm), bunch girth (114 cm), number of hands per bunch (11.70) and yield (149.078 t/ha) (Patel*et al.,* 2010).
SOP at 1.5% or combination of 0.5% potassium di hydrogen phosphate + 1% urea + 20 ppm 2,4-D can be integrated in Nendran banana nutrition as foliar spray twice, first at the time last hand emergence and second 30 days thereafter resulted in obtaining higher fruit yields (Kumar and Kumar, 2009).
Foliar spray SOP (1.5%) significantly increased the number of leaves at harvest, bunch size, and days to maturity, yield, finger number, finger length, girth, and weight (Lahav, 1972).
An experiment was conducted at the Department of Fruit Crops, Tamil Nadu Agricultural University, Coimbatore to evaluate the effect of post shooting spray of SOP on bunch yield and quality of Robusta banana and to integrate SOP on the nutrient management practices of banana. Foliar spray of SOP at 1.5 per cent concentration twice resulted in increased bunch weight with better bunch (Kumar *et al.*, 2008).

An investigation was carried out in Banana cv. Nendran with aiming to improve the bunch and fruit yield characters. The combined foliar sprays of 2% SOP and 2 ppm Brassinosteroid significantly increased the bunch characters *viz.*, bunch weight (11.35 kg), finger weight (215.40 g), finger length (29.10 cm) (Mulagund*et al.*, 2015).

Teaotia*et al.* (1969) reported that polyethylene mulch significantly increased yield of 'Harichal' banana.

While working with mandarin, Rosnadze (1970) also noted the superiority of black polyethylene mulches in respect of yield and tree growth.

Use of black plastic and straw covers in citrus groves raised overall yields by about 30 per cent on the lighter soil; however, on heavy soil straw mulch gave the highest yield (Amami and Haffani, 1973).

Rahovic and Petrovic (1977) reported that black polyethylene mulch increased yield of pears by 14 per cent and that of peaches by 77 per cent.

Bhattacharyya and MadhavaRao (1984) postulated a schematic model for the effect of soil covers and low available soil moisture depletion level on the formation of sink and yield in banana cv. Robusta.

The fruit growth pattern and yield of 'Robusta' banana was influenced considerably by the soil covers and soil moisture regimes (Bhattacharyya and MadhavaRao, 1987).

Influence of different components precision farming on quality characters of banana

The peel: pulp ratio and TSS were significantly increased by application of 100% recommended dose of water soluble feretilizer through fertigation in banana (Raskar, 2000).

Guerra *et al.* (2004) reported that monthly fertigation with 100% RDF gave lower acidity of the fruits compared to side dressing fertilization.

The TSS, total sugar, reducing and non-reducing sugars, sugar acid ratio, pulp-peel ratio and shelf life were significantly increased under drip irrigation at 0.75 EpR and 100% RD of fertilizers through drip while ascorbic acid, titrable acidity were highest with drip irrigation at 1.00 EpR and 100% RDF through drip (Khound, 2007).

Prasad *et al.* (2003) reported that TSS was recorded higher under drip irrigated plants and lowest in control.

Mandal*et al.* (2007) found that TSS, total sugars and vitamin C contents were superior in fruits obtained with drip irrigated guava.

Kumar and Pandey (2008) reported that the maximum and significantly superior values of TSS, total sugars and reducing sugars were observed due to application of 75% RDF + NPK in the ratio of 3:2:1, 1:3:2 and 2:1:3 at vegetative growth, flowering and fruit developmental to maturation stage in banana cv. 'Rasthali' (AAB-Pathkapoora).

Krishnan and Shanmugavelu (1979) in an irrigation trial of banana cv. 'Robusta' found that ascorbic acid increased with the increased in soil moisture status. But TSS, acidity and sugar levels decreased with increased in soil moisture status.

Hedge and Srinivas (1990)reported that TSS of banana fruit increased significantly under basin irrigation as compared to that under drip irrigation in both plant and ratton crop.

Ray (1994) from his experiment in banana cv. Dwarf Cavindish recorded decreased in TSS and sugar and increased ascorbic acid under high level of soil moisture.

Folier application of Fe (0.5%) and Zn (0.5%) in combination showed maximum sugar acid ratio (47.698), non-reducing sugar (10.040%) also showed considerable improvement on TSS (25.53°Brix) and total sugar (17.241%) content of pulp (Pathak*et al.,* 2011).

Foliar application of micronutrient in combination helps in significant increase in peel to pulp ratio, TSS, shelf life of banana (Rashid, 2007).

Foliar as well as soil application of $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%) treatments effectively increased the ascorbic acid content (25 mg/100 g) and total soluble solids (22.0325) in banana fruits (Patel*et al.,* 2010).

In banana, Das (1989) obtained the highest reducing sugar content of 10.19% by combined application of boron+ zinc+ copper+ manganese while the acidity was reduced by the combination of boron+ zinc+ copper+ manganese.

Foliar application of micronutrient mixture of boron + zinc + copper + manganese + iron significantly increased the TSS. Sugar acid ratio, TSS-acid ratio and total sugar content of 'Kew' pineapple (Bhattacharyya, 1988).

In guava combined application of manganese + zinc + boron recorded the highest TSS, total sugar and lowest acid content of fruits (Ghosh, 1986).

Combined treatment of zinc + copper + potassium (0.25% each) reduced the degree of granulation to 0.25% against 23.8% in case of control and it also helped in increasing the total soluble solids and decreasing the acidity resulting in the increase in TSS-acid ratio (Sing and Chohan, 1982).

Combined application of zinc and ferrous sulphate at 1% each was found to be the best in improving fruit quality of kinnow mandarins (Bhullar*et al.,* 1978).

According to Ibrahim and Ali (1970), Mn and Zn caused significant increase in reducing sugar content of pineapple and orange.
In sweet orange, Zn + Cu or Cu spray alone improved fruit quality, increased juice TSS but none of the treatments affected yield (Manchanda*et al.*, 1972).
Talakvadze (1973) reported that in mandarin orange foliar application of Zn (0.1%) increased yield by 1.3% than control.
Casu*et al.* (1980) found that foliar application of NPK + Cu + Mn, Zn + B – vitamin + NAA increased TSS concentration in Clementine tangerine.
Kumar and Kumar (2009) reported that combined application of 0.5% potassium di hydrogen phosphate + 1% urea + 20 ppm 2, 4-D or SOP at 1.5% as foliar spray in banana cv. Nendran helped in increasing good quality fruits.
Kumar *et al.* (2008) reported that foliar sprays SOP at 1.5% concentration twice resulted in enhancing various quality parameters such as TSS, reducing, non-reducing and total sugars and acidity.
Mulagund*et al.* (2015) reported that combined foliar sprays of 2% SOP and 2 ppm Brassinosteroid significantly increased the pulp weight (180.22 g), pulp to peel ratio (5.13) and total bunch yield (29.38 t/ha).
Teaotia*et al.* (1969) reported that polyethylene mulch significantly increased yield of 'Harichal' banana.
While working with mandarin, Rosnadze (1970) also noted the superiority of black polyethylene mulches in respect of yield and tree growth.
Use of black plastic and straw covers in citrus groves raised overall yields by about 30 per cent on the lighter soil; however, on heavy soil straw mulch gave the highest yield (Amami and Haffani, 1973).
Rahovic and Petrovic (1977) reported that black polyethylene mulch increased yield of pears by 14 per cent and that of peaches by 77 per cent.
Bhattacharyya and MadhavaRao (1984) postulated a schematic model for the effect of soil covers and low available soil moisture depletion level on the formation of sink and yield in banana cv. Robusta.
The fruit growth pattern and yield of 'Robusta' banana was influenced considerably by the soil covers and soil moisture regimes (Bhattacharyya and MadhavaRao, 1987).

Influence of different components precision farming on economy of banana cultivation

Pulekar*et al.* (1993) reported that different levels of irrigation had the significant effect on cost benefit ratio of banana. The highest benefit cost ratio (2.28:1) was recorded with irrigation at 25 mm CPE from November to May.
Raskar (2000) reported that B:C was high in fertigation with 100% recommended dose of water soluble fertilizers in case of banana.
Singh *et al.* (2006) recorded that fertigation at 75% level was found to be most economical and profitable fetching the highest net profit and the highest benefit cost ratio in pomegranate cv. Ganesh.
The higher net income (Rs. 71,769) under 60% water through drip and B:C ratio was also recorded most economical in 60% of water through drip in pomegranate crop (Agrawal and Agrawal, 2007).
An investigation was carried out in Banana cv. Nendran with aiming to improve the bunch and fruit yield characters. The combined foliar sprays of 2% SOP and 2 ppm Brassinosteroid significantly increased benefit: cost ratio (2.87) (Mulagund*et al.*, 2015).
An experiment was conducted at the Department of Fruit Crops, Tamil Nadu Agricultural University, Coimbatore to evaluate the effect of post shooting spray of SOP on bunch yield and quality of Robusta banana and to integrate SOP on the nutrient management Practices Of Banana. Foliar Spray Of Sop At 1.5% Concentration Twice Resulted In Higher Benefit: Cost Ratio (1.5) (Kumar *Et Al.*, 2008).

REFERENCES

1. Agrawal, N. and Agrawal, S. (2007). Effect of different levels of drip irrigation on the growth and yield of pomegranate under Chhattisgarh Region.*Orissa J. Hort.***35**:38-46.
2. Aiyappa, K.M.; Srivastava, K.C.; Bajappa, K.M. and Sullamath, U.V. (1968). Studies on the effect of micronutrients sprays singly and in combination on *Citrus reticulate* Blanco (Coorg mandarin seedling). *Indian J. Hort.* **25**:104-113.
3. Amami, E.EI. andHaffani, M. (1973). The effect of mulch on the water balance, tree growth and fruit maturity of the Maltaise orange of Tunosia.*Annals de l'Institut national de la Rechercheagronomique de Tunisie*.**46**: 24. (*Hort. Abst*., **45**: 10084).
4. Ashokaraja, N. (2005). Performance of drip fertigation system for increasing the yield and quality of Muscat grapes. Annual Report of All India Co-ordinated Research Project, Water Technology Centre for Eastern Region, Bhubaneshwar, Orissa, pp. 144-146.

5. Barua, P.K. (1984). Effect foliar spray of micronutrients in relation to urea and ammonium sulphate on growth, yield and quality of pineapple [*Ananascomosus* (L.)Merr.], cv. Kew. M.Sc. (Agri.) Thesis. Assam Agricultural University, Jorhat.
6. Bhattacharyya, A.P. (1988). Effect of foliar application of micronutrient on growth, development, yield and quality of pineapple cv. Kew. M.Sc. (Agri.) Thesis, Assam Agricultural University, Jorhat.
7. Bhattacharyya, R.K. (1982). Studies on the influence of soil cover and soil moisture regimes on banana cv. 'Robusta'. Ph.D. Thesis, Tamil Nadu Agril. Univ., Coimbatore, India.
8. Bhattacharyya, R.K. and MadhavaRao, V.N. (1984). Schematic model for the effect of soil covers and low available soil moisture depletion level on the formation of sink and yield. *Banana News Letter*, International Group of Horticultural Physiology of Banana No. 7, 1984.
9. Bhattacharyya, R.K. and MadhavaRao, V.N. (1987).Fruit growth pattern of 'Robusta' banana as influenced by soil covers and soil moisture regimes.*Banana Newsletter***90**: 5-8.
10. Bhattacharyya, R.K. and MadhavaRao, V.N. (1988). Harvest Index, dry matter production and shoot root ratio of 'Robusta' banana as influenced by soil covers and soil moisture regimes. Paper presented at XXIIndInternational Horticulture Congress, ISHS, California, Aug. 11-20, 1986.
11. Bhullar, J.S.; Farmahan, H.L. and Agnihotri, R.P. (1978). A note On the influence of zinc and iron spray on the fruit quality of kinnow. *Punjab Hort. J.***18**: 148-150.
12. Casu, M.; Dettori, S. and Gass, C. (1980). The effect of foliar application of fertilizers to Clementine trees under condition of stress in relation to absorption by roots. *Informators.Agraric*.**36**: 36 (*Hort. Abst*. **51**: 7382).
13. Chauhan, N.; Chandel, J.S. and Rana Vishal, S. (2007). Fertigation studied in Kiwi fruit (*Actinidiadeliciosa*Chev) growth under mid hill conditions. In :*Souvenir and Abstracts, "Second Indian Horticulture Congress"* 18-21st April. 2007, ICAR Complex for NEH Region, Barapani, Meghalaya, p. 254.
14. Dasberg, S.; Ernes, Y. and Charlzoulakis, K.S. (1997).Effect of irrigation management and nitrogen application on yield and quality of Mineola Mandarin "*proceeding of second International Symposium on Irrigation of Horticulture Crops,*Chania Crete Greece, 9-13th Sept., 1996.*Acta Hort.* **449**: 125-131.
15. Das, P.K. (1989). The effect of micronutrients on growth, yield and quality of banana cvs.'Jahaji' (AAA), 'Barjahaji' (AAA) and 'Chenichampa' (AAB). Ph.D. Thesis, Assam Agricultural University, Jorhat.
16. Figueroa Escobar, A. (1962). Some aspects of the manuring of banana*, Musa paradisica* L. *ActaAgron*.**12**:125-139 (*Hort. Abst.***33**: 808).
17. Ghode, P.B. and Joshi, P. (2007).Fertigation studies in acid lime production. In :*Souvenir and Abstracts, "Second Indian Horticulture Congress"* 18-21st April. 2007, ICAR Complex NEH Region, Barapani, Meghalaya, p. 254.
18. Ghosh, S.N. (1986). Effect of Mg, Zn, B, and Mn on yield and fruit quality of guava cv. Lucknow-49.*South Indian Hort*. **34**: 327-330.
19. Guerra, A.G.; Zanini, R.J. and William, N. (2004). Frequency of fertigation with nitrogen and applied by microsprinkler system on prata-ana-banana plant. *Eng. Agric*. **24**: 1201-1209.
20. Hasan, M.A. and Sirohi, N.P.S. (2006). Drip Irrigation and Fertigation Technology for Improving water Productivity of horticultural crops *National Seminar on Technological Options for Improving Water Productivity in Agriculture.* JNKVV, Jabalpur. Nov. 15-17.
21. Hedge, D.M. and Srinivas, K. (1990).Growth, production and water use of banana under drip and basin irrigation in relation to evaporative replenishment.*Indian J. Agron.***35**:106-112.
22. Holder, G.D. and Gumbs, F.A. (1983).Effect of nitrogen and irrigation on the growth and yield of banana.*Trop. Agric.***60**: 179-189.
23. Ibrahim, M. and Ali, N. (1970).Effect of foliar sprays of Zn and Mn on nitrogenous and carbohydrate contents of citrus leaves.*Pakistan J. Sci*. **22**:239-243.
24. Jains, B. (2004). Hi-tech banana production practices. www.jains.com.
25. Khound, A. (2007). Drip irrigation and fertigation in banana cv. Barjahaji (AAA). M.Sc. (Agri.) Thesis, AAU, Jorhat.
26. Krishnan, B.M. and Shanmugavelu, K.G. (1979).Studies on water requirements of banana cv. 'Robusta'.Effect on morphological character, crop duration yield and quality of fruits.*Mysore J. Agric. Sci.***13**: 433-441.
27. Kumar, D. and Pandey, V. (2008).Effect of NPK fertigation on growth, yield and quality of banana 'Rasthali' (AAB-Pathkapoora) in coastal agro-climatic conditions of eastern India.*Indian J. Agric. Sci.***78**: 798-800.
28. Kumar, R.A. and Kumar, N. (2009).Effect of post-shooting spray of certain nutrients on yield and quality of banana cv. Nendran (AAB- Plantain).*Asian J. Hort.***4**: 328-330.
29. Kumar, R.A.; Kumar, N. and Jeyakumar, P. (2008).Effect of Post-shooting Spray of Sulphate of Potash (SOP) on yield and quality of Banana cv. Robusta (AAA- Cavendish).*Res. J. Agri. Bio. Sci*.**4**: 655-659.
30. Lahav, E. (1972). Sulphate of Potash Foliar Spray Effects on yield, quality, and post-harvest life of Banana *Trop. Agric*. Trinidad **49**: 321-335.
31. Manchanda, H.R.; Sukla, U.C. and Randhawa, N.S. (1972).Effect of soil and foliar application of Zn and foliar application of Cu, Mn, Fe alone and in combination with Zn on the incidence of Chlorosis, fruit fall, granulation and fruit quality of sweet orange (*C. Sinensis* L. osbeck) var. Blood Red.*Ind. J. Hort*. **29**: 19-29.
32. Mandal, G.; Kumar, R. and Singh, R. (2007). Effect of drip irrigation and plant spacing on yield, quality and economic return of guava (*Psidiumguajava* L.) grown in saline soil. *Acta Hort.***735**: 427-432.
33. Mathew, J. (2003). Drip irrigation – A successful technology for integration and fertilization with multiple benefits. *Krishan World*. **30**: 50-51.
34. Mukesh, A.A. (2001). Fertigation in horticultural crops.*Kisan World***28**: 25.

35. Mulagund, J.; Kumar, S.; Soorianathasundaram, K. and Porika, H. (2015). Influence of post-shooting sprays of sulphate of potash and certain growth regulators on bunch characters and fruit yield of banana cv. Nendran (French plantain Musa AAB).
36. Nagaranjan, S.S. (2001). The miracle of drip irrigation for establishing flourishing mango orchards in marginal and submarginal lands.*Kisan World***28**: 51.
37. Oganov, G.M. and N.S. Talyboc, (1973).The effect of foliar nutrition on grape yield and quality.*Ref. Zhurnal* 11.55.962 (*Hort. Abst.***44**:55 14).
38. Pant, P.C. (1969). Effect of minor elements on pre-harvest cracking of apple var. Coxs Orange Pippin.*Progressive Hort*. **1**: 19-22.
39. Patel, A.R.;Saravaiya, S.N.; Patel, A.N.; Desai, K.D.; Patel, N.M. andPatel, J.B. (2010).Effect of micronutrients on yield and fruit quality of Banana (*Musa paradisica*L.) cv. Basrai under pair row planting method.*Asian J. Hort.* **5**: 245-248.
40. Pathak, M.; Bauri, F.K.; Misra D.K.; Bandyopadhyay, B. and Chakraborty, K. (2011).Application of micronutrients on growth, yield and quality of banana.*J. Crop Weed.* **7**:52-54.
41. Prasad, R.N.; Bankar, G.J. and Vashishtha, B.B. (2003).Effect of drip irrigation on growth, yield and quality of pomegranate in arid region.*Indian J. Hort*. **60**: 140-142.
42. Pulekar, C.S.; Salvi, B.R.; Jadhav, S.M. and Patil, B.P. (1993).Water use and productivity of banana as influenced by irrigation schedules and grass mulch in Lateritic soil of Konkan.*J. Water Mgnt.***1**: 39-42.
43. Ray, C.C. (1994). Effect of irrigation and mulching on growth, yield and quality of banana cv. 'Dwarf cavendish'. M.Sc. (Agri.) Thesis, Assam Agricultural University, Jorhat.
44. Rahovic, D. and Petrovic, M. (1977).Effect of blackpolyethylene film on the vegetative growth, yield and quality of pear and peaches in dense planting, *Jugoslovenskovocarstvo*, **10**: 555-559. (*Hort. Abst*. **49**: 1735).
45. Ramasubba Reddy, M. and Srinivasulu, B. (2004).Fertigation boosts banana yield. www.theHindu.com.
46. Rashid, Ar. H. Md. (2007). Effect of micronutrient and their method of application on growth yield and quality of banana. M.Sc. (Agri.) Thesis, Bangladesh Agricultural University, Mymensingh.
47. Raskar, B.S. (2000). Effect of planting technique and fertigation on growth, yield and quality of banana (*Musa* sp.).*Indian J. Agron.***48**: 235-237.
48. Rosnadze, G.R. (1970). The effectiveness of mulching mandarin plantation with polyethylene film.*Hort. Abst*. **42**: 4785.
49. Sanders, D.C.; Howell, T.A.; Hile, M.H.S.;Hodge, L. and Meek, D. (1989).Yield and quality of processing tomatoes in response to irrigation rate and schedule.*J. Amer.Soc. Hort. Sci.***114**: 904-908.
50. Singh, M.I. and Chohan, G.S. (1982). Effect of nutritional sprays on granulation in citrus fruit cv. Wilking mandarin. *The Punjab Hort. J.***22**:52-59.
51. Singh, P.; Singh, A.K. and Sahu, K. (2006).Irrigation and fertigation of pomegranate cv. Ganesh in Chattisgar.*Indian J. Hort.***61**: 148-151.
52. Salvin, S. (1999). Drip irrigation studies in banana cv. 'Barjahaji' (Musa AAA group, Cavendish subgroup). M.Sc. (Agri.) Thesis, Assam Agricultural University, Jorhat.
53. Talakvadze, K.B. (1973).The effect of soil and foliar applied minor elements on Mandarin Yield.*Sub-tropicheskieKultury*.**3**: 50-60 (*Hort. Abs*. **44**: 6070).
54. Teaotia, S.S.;Tripathi, R.D.;Tripathi, R.S. and Singh, R.P. (1969).Effect of irrigation frequencies and mulches on growth, yield and chemical composition of fruit of banana (*Musa cavendishii*) var. Hirachal.*Hort. Sci*. (Calcutta) **1**: 23-31.
55. Tungoe, Y.M. (2011).studies on drip irrigation and nutrient interaction banana cv. Jahaji (AAA). M.Sc. (Agri.) Thesis, Assam Agricultural University, Jorhat.
56. Yuan, B.Z.; Sun, J. and Nishiyama, S. (2004). Effect of drip irrigation on strawberry growth and yield inside a plastic greenhouse.*Biosys. Eng*. **87**: 237-245.

CITATION OF THIS ARTICLE

Utpal Das, R.K.Bhattacharyya, Purnima Pathak. A Review Of Works Done Regarding Precision Farming In Banana. Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue 2, 2017: 354-360