Current Journal of Applied Science and Technology

37(6): 1-6, 2019; Article no.CJAST.52155
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Conservation Practice, Irrigation and Fertilizer Dose Influence Yield and Quality of Mango cv. Amrapali under High Density Orchard in *Kosi* Zone of Bihar

Radhey Shyam[1,2*], Suraj Prakash[1,2] and Janardan Prasad[1,2]

[1]Bhola Paswan Shastri Agricultural College, Purnea, India.
[2]Bihar Agricultural university, Sabour-815302, Bhagalpur, Bihar, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2019/v37i630337
Reviewers and Editors: This manuscript was reviewed and approved by ICCRM-2019* Organising committee.

Original Research Article

Received 23 September 2019
Accepted 02 October 2019
Published 15 October 2019

ABSTRACT

An investigation was carried out during three consecutive years from 2016-17 to 2018-19 at farm of B.P.S. Agricultural college, Purnea on Mango cv. Amrapali to study the effect of conservation practice of mulch with irrigation and fertilizer levels on yield and soil parameter, fruit yield and its qualities of mango grown in kosi zone of Bihar. The experiment was laid out in split split plot design with three replications. Experimental findings revealed that conservation practices as mulch significantly increased fruit set, fruit retention, fruit yield and fruit quality. Among different irrigation levels and fertilizer doses maximum fruit yield (23.24 ton/ha) was obtained under conservation practice with 75% recommended irrigation along with 100% RDF which was at par with conservation practice with 75% recommended irrigation along with 75% RDF. Conservation treatment also showed maximum TSS (23.69° Brix) with maximum (0.39%) acidity of fruit. Observations also revealed that conservation practices as mulching significantly increased the soil moisture content, organic carbon %, available soil N, P and K, along with increase soil microbial population. Among the different fertilizer levels highest organic carbon %, available soil N, P and K, as well as soil microbial population were observed with 100% RDF, however only organic carbon and available soil P were at par with 75% RDF.

Keywords: Conservation; mulches; Mangifera indica; quality; yield.

**Corresponding author: E-mail: see2rsmaurya@gmail.com;*
** Note: This paper was presented in International Conference on Crop Residue Management (ICCRM-2019), October 14-15, 2019, Patna, Organised by Bihar Agricultural University, Sabour, Bhagalpur - 813210 (Bihar), India. Conference organising committee completed peer-review of this manuscript.*

1. INTRODUCTION

Conservation agriculture by Mulches has a substantial impact on enhancing the sustainable yield and quality of fruit. Mulching is the process of covering the soil surface around the plants with an organic or synthetic material to create congenial condition for the plant growth, development and efficient production. Mulching of organic and inorganic materials create favourable conditions for getting maximum production of quality fruits on sustainable basis within the limits of soil, water and fertility management [1], (Ghosh et al., 2015). It improves the physical and chemical qualities of the soil and availability of nutrient pool and biological qualities by increasing beneficial soil microbes. Mulches impart manifold beneficial effect, like stabilization of soil temperature, reduced water loss through evaporation,resulting more stored soil moisture, which is utilized by the crop plants especially in the dry season [2], suppression of weed growth [3], improvement in growth and yield [4].

The practice of applying a layer of dead vegetative wasteas mulch to the soil surface has beenprevalent for a very long time.The mulching materials of organic origin are known tocontribute plant nutrient elements to the plant and increases the aggregate stability and structureof soil add nutrients and humus to the soil as they decompose, improving its tilth and moisture holding capacity [5]. A number of innovative and efficient technologies has been adopted such as smart irrigation systems, smart fertilizers [i.e., controlled release fertilizer and enhanced efficiency fertilizers (EEFs), etc.], integrated fertilization, and diseases biocontrol strategies as well as diverse imaging- and sensing-based technologies that provide highly valuable information for monitoring and securing crop productivity [6].

Irrigation water and fertilizer are the valuable agriculture inputs affected the crop growth and yield. The farmer crop is generally grown with surface irrigation, which has low water and fertilizer use efficiency. So improvement in irrigation practices along with suitable fertilizer dosesare needed to increase crop production and to sustain productivity levels.

But, scanty information isavailable regarding use of conservation practices in mango cropand its effect with requirement of irrigation and fertilizer doses. Keeping this in view, the presentinves-tigation was carried out to study the effect of conservation agriculture along with irrigation and fertilizer use on growth, yield and quality of mango cv. Amrapali in Kosi zone of Bihar.

2. MATERIALS AND METHOD

The present investigation was carried out at farm of Bhola Paswan Shastri Agricultural College, Purnea (Bihar) for three consecutive years during 2016-17 to 2018-19 in a seven year aged well managed healthy mango orchard cv. Amrapali having uniform growth and vigour spaced at 2.5 m x 2.5 m apart in high density planting. The soil of the experimental field was sandy loam in texture having neutral pH (6.89) with low Organic carbon (0.35%), low available N 187.18 kg/ha and P_2O_5 9.2 kg/ha and medium available K_2O 150.5 kg/ha. The mean annual rainfall is 1,430 mm, out of which 80-90% is normally received from June to September. The water level is below 3 meter during crop growth period. The experiment consists of two treatments in main plot viz. conservation system (mulching with dry banana leaves) and conventional system (no mulch) as well as two irrigation levels in subplot viz. 100% Recommended irrigation (RI) and 75% RI with three fertilizer levels viz. 100% Recommended dose of fertilizer (RDF), 75% RDF and 50% RDF in sub-sub plot. The experiment was laid out in split-split plot design with replicated three times and each plot consisted of nine plants. The mulches were applied in the month of Feb- March around the trunk of the tree to a thickness of 8-10 cm. Mulches were kept in the field for one year. The plants were fertilized as per the treatment. Plant protection measure was also done if needed.

Soil moisture content at 50-75 cm depth was determined gravimetrically at weekly intervals. The qualities of ripe fruits was analysed following the standard methods as described by Ranganna [7]. The juice extracted from 10 fruits was taken for determination of fruit quality. The TSS was estimated using digital refractometer and expressed as ^{o}Brix. Titratable acidity was determined by titrating 5 ml of juice against 0.1 N NaOH and expressed as %.

Soil nutrients were also estimated by the methods as N [8], P_2O_5 [9] and K_2O [10]. To estimate the number of soil microbial, sample was taken from 10-15 cm depth and microbial counts were calculated on the basis of serial 10 fold dilution technique, using the pour plate methods and replicate of 10 g soil samples, and an appropriate dilution as described by Johnson and Curl, [11]. Soil microbial population

expressed as Colony forming units per g of soil (cfu g^{-1}) that calculated using the equation of James (1978).

$$Colony\ forming\ unit\ \left(\frac{cfu}{g}\ soil\right) = \frac{No.of\ colonies \times dilution\ factor}{Volume\ of\ inoculum}$$

The data were analysed statistically by the analysis of variance as suggested by Goon et al. [12].

3. RESULTS AND DISCUSSION

3.1 Effect on Yield Parameter and Fruit Yield

Perusal of pooled data from Table 1 revealed that mulches in conservation agriculture significantly increased the no of flower/ panicle (4460.4), fruit set (63.72%) and fruit retention (0.47%), yield /plant and finally the mango yield (20.81 t ha^{-1}) over the conventional practices (no mulch). The fruit drop percentage was recorded lower in case of mulch application over non mulch but the differences were found non-significant. No of flower/panicle as well as fruit drop% were recorded significantly higher in 100% recommended irrigation than 75% recommended irrigation. But fruit retention (0.25%), fruit yield/plant (11.50 kg) were obtained significantly higher in 75% recommended irrigation as compared to 100% recommended irrigation. No of flower /panicle were recorded significantly higher in 100% recommended dose of fertilizer over others. But fruit set % were obtained at par with in 100 and 75% recommended irrigation but significantly higher as compared to 50% recommended irrigation. 100%RDF at par with 75% RDF recorded significantly higher fruit retention %, yield/plant and total fruit yield.

The interaction effect of conservation practices as mulch, irrigation, fertilizer levels presented in Table 2. The result reveals that Interaction of different treatments resulted to maximum fruit yield in conservation practices as mulch with 75% recommended irrigation and 100%RDF (23.24 ton/ha) followed by conservation practices with 75% recommended irrigation and 75%RDF as well as 50%RDF. But under conservation practice as mulch, with All the fertilizer dose recorded significant variation in total fruit yield along with 100% recommended irrigation. In conventional practices as unmulch, highest yield was observed with 100% recommended irrigation with 50% RDF (16.96 t ha^{-1}), however lowest in 75% recommended with 50% RDF. Such an improvement in treatment is due to regulation of moisture and nutrient availability in soil hydro-thermal regime by conservation practices. Similar finding were also reported by Dutta and Majumder [13] in guava and Das et al. [14] in litchi.

3.2 Effect on Fruit Quality

The TSS was significantly higher in conservation (0.39°Brix) than conventional (0.29°Brix). However the differences in TSS were owing to non significant due to different treatments of irrigations as well as fertilizer doses. However Acidity was at par with 100 and 75 percent recommended dose of fertilizer. The variation in acidity was also found significant with conservation practices with mulch as well as 75% recommended irrigation and recorded highest acidity. Our results corroborate with the results of Dutta and Majumder [13] in Guava, Singh et al. [15] in aonla and Bhusan et al. [16] in mango.

Table 1. Effect of conservation practices, irrigation and fertilizer dose on yield parameter, fruit yield and qualities of mango cv. Amrapali

Treatment	No of flower/ panicle	Fruit drop (%)	Fruit set (%)	Fruit retention (%)	Yield/ plant (Kg)	Total fruit yield (ton/ha)	TSS (°Brix)	Acidity (%)
Conservation	4460.4	89.67 (9.49)	63.72 (8.01)	0.47 (0.99)	13.01	20.81	24.4	0.39
Conventional	3344.6	96.67 (9.86)	43.88 (6.65)	0.09 (0.77)	9.38	15.14	22.7	0.29
CD (P=0.05)	363.2	NS	0.17	0.01	1.14	2.38	1.34	0.02
100% RI	3963.9	94.43 (9.75)	52.29 (7.23)	0.25 (0.86)	10.89	17.55	23.36	0.33
75 % RI	3841.1	91.90 (9.60)	55.31 (7.43)	0.31 (0.89)	11.50	18.40	23.69	0.36
CD (P=0.05)	110.1	0.14	NS	0.01	0.54	1.49	NS	0.01
100%RDF	4121.5	93.24 (9.68)	55.52 (7.46)	0.32 (0.88)	11.49	18.38	23.69	0.36
75% RDF	3919.6	92.87 (9.66)	55.74 (7.48)	0.27 (0.87)	11.19	17.91	23.60	0.35
50% RDF	3666.4	93.40 (9.69)	50.14 (7.05)	0.25 (0.85)	10.99	17.66	23.27	0.33
CD (P=0.05)	175.0	NS	0.11	0.01	0.49	0.57	NS	0.01

Table 2. Interaction effect of conservation practices, irrigation and fertilizer dose on total fruit yield of mango cv. Amrapali

Treatment			Total fruit yield (ton/ha)
Conservation	100% RI	100%RDF	20.19
		75% RDF	18.88
		50% RDF	17.66
	75 % RI	100%RDF	23.24
		75% RDF	22.48
		50% RDF	22.22
Conventional	100% RI	100%RDF	15.44
		75% RDF	16.19
		50% RDF	16.96
	75 RI	100%RDF	14.43
		75% RDF	14.08
		50% RDF	13.76
CD(P=0.5)			1.13

Table 3. Effect of treatments on soil physico-chemical properties and microbial population

Treatment	Soil moisture (%) at 50-75 cm depth	Organic carbon (%)	Available N (kg ha^{-1})	Available P_2O_5 (kg ha-1)	Available K_2O (kg ha-1)	Soil microbial population (cfu g^{-1} soil)
Conservation	9.18	0.39	148.6	10.8	159.3	$3.5x\ 10^6$
Conventional	3.34	0.34	124.1	9.4	146.6	2.7×10^6
CD (P=0.05)	4.12	0.02	5.9	0.7	5.9	-
100% RI	7.62	0.37	144.7	10.5	155.8	3.3×10^6
75 % RI	4.58	0.36	127.2	10.1	151.4	3.0×10^6
CD (P=0.05)	2.25	NS	4.2	0.3	3.5	-
100%RDF	4.15	0.38	145.2	10.7	160.7	3.3×10^6
75% RDF	4.03	0.38	136.1	10.4	148.3	$3..1 \times 10^6$
50% RDF	3.97	0.36	128.3	9.7	144.1	8.8×10^5
CD (P=0.05)	NS	0.01	2.5	0.3	2.2	-

3.3 Effect of Soil and Microbial Properties

Perusual of data on soil properties and microbial population revealed that conservation practices as mulches significantly increased the soil moisture content upto 9.18% over conventional practices as unmulched plants (3.34%) (Table 3). High moisture retention ability in conservation could be due to less evaporation from soil. The water vapours that evaporate from the soil surface further trapped in mulch material into the upper soil surface which increases soil moisture content in the root zone Noman Khan et al. [17]. Such an improvement in soil hydrothermal regime with mulching was also reported on several other tropical species such as guava cv. L-49 [13], mango fruits cv. Himsagar [18].

The soil organic carbon per cent and soil nutrient contents (N, P and K) were also influenced by the application of conservation practices as mulches and had significant higher organic carbon (0.39%), nitrogen (148.6 kg ha^{-1}), phosphorus (10.8 kg ha^{-1}) and potassium (159.3 kg ha^{-1}) over conventional practices treatments. Higher available nutrient pool in the soil under conservation practices as mulch was the result of mineralization of organic matter. Similar result was also obtained by Dutta and Majumder [13] in guava. Highest soil microbial population was also observed in conservation practices of mulch (3.6×10^6 cfu g-1 soil). Micro-organism is an important component of soil environment [19]. There larger number is indicative of better soil health [20] and improved nutrient availability to plant and the fruits. Organic mulch are efficient in improve soil physical properties, supply organic matter, regulate temperature and water retention, improve nutrient balance and recycling as well as increase the biological activity [21,22,23].

Observation on soil properties recorded that 100% recommended irrigation significantly increased the soil moisture content over 75% recommended irrigation. High moisture in 100%

recommended irrigation could be due to more application of water.

The variations in soil nutrient contents (N, P and K) were found significant by the application of 100% RI as compared to 75% RI. Highest soil microbial population was also observed with 100% RI, which may be due to more congenial soil environment for micro-organism and facilitate higher available nutrient pool in the soil.

Soil moisture content did not have significant influenced by different fertilizer levels but organic carbon and soil nutrient contents (N, P and K) significantly varied by the application of 100% RDF than 50% RDF. Higher available soil nutrient may be due to application of more chemical fertilizer which cause early mineralization of organic matter that favour high microbial population. Highest soil microbial population was also observed with 100% RDF (3.3×10^6 cfu g^{-1} soil).

4. CONCLUSION

The conservation practices as mulch with 75 percent recommended irrigation along with 75% recommended dose of fertilizer gave the significant higher mango fruit yield with in conservation practices with maximum TSS and acidity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bakshi P, Wali VK, Iqbal M, Jasrotia A, Kour K, Ahmed R, Bakshi M. Sustainable fruit production by soil moisture conservation with different mulches: A review. African Journal of Agricultural Research. 2015;10(52):4718-4729.
2. Shirgure PS, Sonkar AK, Singh S, Panighrah P. Effect of different mulches on soil moisture conservation, weed reduction, growth and yield of drip irrigated Nagpur mandarin (*Citrus reticulata*). Indian J. Agric. Sci. 2003;73:148-52
3. Kaur K, Kaundal G. Efficacy of herbicides, mulching and sod cover on control of weeds in plum orchards. Indian J. Weed Sci. 2009;104:110-12.
4. Pande KK, Dimri DC, Prashant K. Effect of various mulches on growth, yield and quality of Apple. Indian J. Hort. 2005;62: 145-47.
5. Ganeshamurthy AN, Rupa TR, Shivananda TN. Enhancing mango productivity through sustainable resource management. J. Hortl. Sci. 2018;13(1):1-31.
6. Bargaz A, Lyamlouli K, Chtouki M, Zeroual Y, Dhiba D. Soil microbial resources for improving fertilizers efficiency in an integrated plant nutrient management system. Frontiers in Microbiology. 2018;9.
7. Ranganna S. Hand book of analysis and quality control for fruits and vegetable products. 3rd Ed. Tata McGraw Hill Publishing Company Limited 7, West Patel Nagar, New Delhi; 2003.
8. Black CA. Methods of soil analysis, soil science society of American, Inc. Publisher, Madison, Wisconsin, USA. 1965;117-174.
9. Jackson ML. Soil chemical analysis practice Hort., USA. James, G.C. 1978. Natallic Sherman Rockland Community College, State University of New York, The Benjamin/Coming publishing Company. 1960;75–80.
10. Piper CS. Soil and plant analysis. Practice Hort., USA. Purseglove, J.W. 1972. Mangoes of West India. Acta Hort. 1956;24:107-174.
11. Johnson LF, Curl EA. Methods for research on the ecology of soil-borne plant pathogens. Burgess, Minneapolis, MN. 1972;7-14.
12. Goon AM, Gupta MK, Dasgupta B. Fundamentals of statistics. The World Press Limited, Calcutta. 2001;2:72-76.
13. Dutta P, Majumder D. Effect of mulching on post harvest quality of guava cv. L-49 grown in red and laterite tract of West Bengal. Adv. Hort. Sci. 2009;23(3):175-178.
14. Das K, Sau S, Sarkar T, Dutta P. Effect of organic mulches on yield, physico-chemical qualities and leaf mineral composition of litchi cv. Bombai in Indo-Gangetic plain of West Bengal. Journal of Crop and Weed. 2016;12(3):67-69.
15. Singh AK, Singh S, Rao VVA, Bagle BG, More TA. Efficiency of organic mulches on soil properties, earthworm population, growth and yield of aonla cv. NA7 in semi-arid ecosystem. Indian J. Hort. 2010;67: 124-28.
16. Bhusan PL, Panda C, Dash KA. Effect of pre-harvest chemical treatments and mulching on marketability of mango (*Mangifera indica* L.) cv. Amrapali. J. Crop Weed. 2015;11(1):216-19.

17. Noman Khan M, Ayub G, Ilyas M, Khan M, Haq. UlF, Ali J, Alam A. Effect of different mulching materials on weeds and yield of Chili cultivars. Pure Appl. Biol. 2016;5(4): 1160-1170.
18. Ghosh SN, Duttaray SK, Megu O. Effect of mulching and irrigation on fruit yield and quality of sweet orange (*Citrus sinensis* L.) cv. Mosambi. Int. J. Agric. Environ. Biotechnol. 2009;2(1):42-45.
19. Arshad M, Frankenberger Jr. WT. In Meting Jr FB (ed). Microbial production of plant growth regulators. Soil Microbial Ecology, Mavcel Dekker, Inc. New York. 1992;307-348.
20. Barea JM, Navarro EM, Ontoya E. Production of plant growth regulators by rhizophere phosphate solubilizing bacteria. Journal of Appl. Bacteriology. 1976;40: 129-134.
21. Hooks CRR, Johnson MW. Impact of agricultural diversification on the insect community of cruciferous crops. Crop Protection. 2003;22:223-238.
22. Muhammad AP, Muhammad I, Khuram S, Anwar-UL Hassan. Effect of mulch on soil physical properties and NPK concentration in Maize (*Zea mays*) shoots under two tillage system. International Journal of Agriculture & Biology. 2009;11:120-124.
23. Sarolia DK, Bhardwaj RL. Effect of mulching on crop production under rainfed condition: A review. Int. J. Res. Chem. Environ. 2012;2:8-20.