The Bioscan 9(1): 561-564, 2014
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EFFECT OF DIFFERENT ORGANIC MULCHING MATERIALS ON SOIL PROPERTIES OF NA '7' AONLA (*EMBLICA OFFICINALIS* GAERTN) UNDER RAINFED CONDITION OF SHIWALIK FOOTHILLS OF HIMALAYAS INDIA

VIJAY KUMAR*
Rainfed Research Sub-station for Sub-tropical fruits, Raya
Sher-e-Kashmir University of Agricultural Sciences and Technology Jammu - 181 143, INDIA
e-mail: vijaykumar.1144@yahoo.com

KEYWORDS
Mulch
Soil pH
Soil EC,
OC
N, P, K
Kandi

Received on :
17.01.2013

Accepted on :
22.03.2014

***Corresponding author**

ABSTRACT
An experiment was conducted during 2009-2011 to assess the effected different organic mulches (Bajra straw, Maize straw, Palah leaves (*Butea monosperma*), Branker (*Adhatoda vassica*), Farmyard manure) on soil properties in NA '7' aonla (*Emblica officinalis* Gaertn). Different organic mulches significantly increased the soil organic carbon and nutrients. Soil properties were highest in FYM and lowest in control. In the present study the effect of mulching type on soil characters including soil pH, EC, OC, Available N, P and K was evaluated during two years. This research was conducted as randomized block design with four replications. In this study, soil pH, OC (organic carbon), EC, N, P and K in 0 to 15 cm soil depth was measured. Results showed that effect of type of mulch on soil pH and soil EC was not significant among all the treatments, while on OC (organic carbon), N, P and K was significant in all treatments. Farmyard manure mulch recorded highest soil organic carbon (6.60 and 6.80 g kg^{-1}), Soil available nitrogen (238.00 and 239 kg ha^{-1}), Soil available Phosphorus (20.12and 21.00 kg ha^{-1}) and Soil available Potassium (169.92 and 179.48 kg ha^{-1}) in 2009 and 2010 followed by branker (*Adhatoda vassica*). Maize straw mulch with 0-15 cm thickness has the highest reduction of soil pH and EC in all types of mulch. FYM with 0-15 cm thickness has the highest percentage of OC, N, P and K. Farmyard manure and Branker (*Adhatoda vassica*) have the greatest effect on soil organic carbon and available nutrients.

INTRODUCTION

Aonla or Indian gooseberry (*Emblica officinalis* Gaertn) has become the important fruit crop of arid and semi–arid region of the country because of its hardy nature that makes it suitable to grow in varied edephoclimatic conditions of such regions. The major constraints are moisture stress and inherently poor soil fertility. The uses of mulches help to reduce water consumed (Keramat *et al*., 2011). The main functions that mulches provide including: weed suppression, soil water conservation, moderation of soil temperature fluctuations (daily and seasonal), increased infiltration of water droplets from precipitation or irrigation, soil protection from traffic compaction, improved soil structure for organic mulches and the slow release of nutrients. Mulches not only conserve soil moisture but also impart manifold beneficial effects, like suppression of extreme fluctuation of soil temperature and reduction of water loss through evaporation, resulting is more stored soil moisture (Shirugure *et al*., 2003), maintenance of soil fertility (Slathia and Paul, 2012). The requirement of water through mulch can further be reduced by using locally available organic materials as mulches which not only save irrigation water but also conserves soil moisture. Various studies have indicated that in fruit crops like apple, sapota and acid lime, mulching improves soil moisture status, growth, yield and quality of these fruits, besides reducing weed growth (Shirugure *et al*., 2005, Abouziena *et al*., 2008). Continuous uses of organic mulches are helpful in improving the physico-chemical properties microbial flora and soil aeration (Rao and Pathak, 1998). Moreover, mulching with plastic polyethylene is found effective in conserving the soil moisture and increasing the growth, yield and quality in different citrus cultivars (Lal *et al*., 2003, Shirugure *et al*., 2005). Considering the beneficial effect of mulching, this investigation was undertaken to assess the effect of organic mulches on soil properties of Aonla in rainfed condition.

MATERIALS AND METHODS

A study was carried out on 12 years old plants of 'NA-7' aonla which were planted in 1997 at a spacing of 8m x 8m these plants were treated with different mulches at Rainfed Research Sub-station for sub-tropical fruits Raya, Sher-e- Kashmir University of Agricultural Sciences and Technology Jammu during 2009 to 2010. The experiment was laid out in a randomized block design with 6 treatments and four replications. Different organic mulches viz bajra straw, maize straw, palah leaves (*Butea monosperma*), brankad (*Adhotada vassica*), farmyard manure were imposed uniformly on the basin (10 cm thickness) during April. Without mulch was applied in control plots. Other cultural practices adopted were similar for all treatments. Nutrient management and other horticultural operations were carried out as per standard

practices under rainfed conditions. The surface (0-15 cm) soil samples were analyzed for the properties i.e. soil reaction by pH metre, EC by EC metre, Organic carbon in soil was determined by Walkley and Black's rapid titration methods as suggested by Piper. Available N was estimated by using alkaline KMnO4 method as suggested by Subbiah and Asija, (1956). Available P content of the soil was extracted with Sodium bicarbonate by Olsen *et al*., (1954). It was determined in the neutral normal ammonium acetate extract of soil through Flame photometer.

RESULTS AND DISCUSSION

Soil pH

Results showed that effect of different type of mulches on soil pH (Fig. 1.). The highest soil pH was observed without mulch and lowest in maize straw tree basin both the years 2009-10. The soil pH of the tree basin showed some reduction in their values, but the difference was non- significant. When rainfall or irrigation water passed through mulching materials, this layer can affected the lower soil layer by absorption or solving some materials. The soil pH decreased might be due to addition of organic matter after decomposition of mulches; which releases organic acids and dissolve them from their soluble form. These findings are in close conformity with the results of Rao and Pathak (1998).

Soil EC

The result revealed that effect of different type of mulches on soil EC (Fig. 2.). The highest soil EC was observed without mulch and lowest in palah leaves of tree basin in 2009-10. The soil EC of the tree basin showed some reduction in their values, but the difference were non significant. It seems that mulch can reduce soil EC in two ways, A: mulches reduced water evaporation of soil and so lead to reducing salt accumulation in soil; and B: water-soluble salts may be absorbed by mulch layer and lead to reducing of water EC when it reaches to the soil layer. Hild and Morgan (1993) reported that the greatest effect of mulches on soil EC was observed in the surface soil layer below the mulches. They also found that using mulch reduces water evaporation and maintains soil moisture. Therefore lead to reducing the accumulation of soluble salts in the soil surface and electrical conductivity of soil can be reduced. The results of present study were in close agreement with their results.

Soil organic carbon g kg^{-1} (SOC g kg^{-1})

Soil Organic Carbon was significantly affected by different types of mulch ($p = 0.05$) (Fig. 3.). The highest soil organic carbon was observed in farmyard manure followed by brankad (*Adhotada vassica*), maize straw, bajra straw, palah leaves and lowest without mulch of tree basin both the years 2009-10. Mulching can contribute to such a development by improving organic matter content in the soils and by affecting other soil characteristics (Ferrini *et al*., 2008). Farmyard manure is high nutrient status than other mulching treatment. Annual incorporation of the farmyard manure into the soil caused the highest content of soil organic carbon. Tree basin previously mulched with bajra straw, maize straw, palah leaves and branker still showed a higher content of SOC than the unmulched tree basin. Although grass mulch quickly decomposes, the amount of soil organic matter (SOM) in the tree basin previously mulched with grass was higher compared with the unmulched tree basin. The results of these studies confirm that long organic farming positively influences the amount of SOM (Lagomarsino *et .al*., 2009). It was observed that farmyard manure, brankad, maize straw, bajra straw and ficas leaf decomposed after rainy season and added lot of humus to the soil. Aonla is deciduous plant and lot of litter is also decomposed from foliage. Covering the soil with different type of mulches can improved environmental condition for soil organism by preventing water and wind erosion, inhibiting drastic variation in humidity and temperature and by increasing organic matter as a source of nutrition. Thus it can provide a more stable environment for soil invertebrates (Jodaugiene *et al*., 2010).

Soil available nitrogen Kg ha^{-1} (SAN Kg ha^{-1})

Results showed that the significantly ($p = 0.05$) effect of different type of mulches on soil available nitrogen (Fig. 4.). The favourable effect of organic mulches on increasing the available plant nutrient content in the soil is well documented. The highest soil available nitrogen was observed in farmyard manure followed by brankad (*Adhotada vassica*), maize straw, bajra straw, palah leaves and lowest without mulch of tree basin both the years 2009-10. Under optimum conditions the available nitrogen concentration was higher in soil from mulched compared to un-mulched tree basin. In other studied higher activity of nitrifying bacteria in soil observed where organic matter as farmyard manure, glucose or cellulose had been added. So they suggest that the addition of farmyard manure to the soil either increases the NH^{+4} level from

Table 1: Effect of different organic mulching on soil properties of NA '7' Aonla (Emblica Officinalis Gaertn) (2009-2010)

Treatment	Soil pH(1:2.5)		Soil EC (dSm^{-1})		Soil organic carbon (g kg^{-1})		Available nitrogen (kg ha^{-1})		Available phosphorus (kg ha^{-1})		Available potassium (kg ha^{-1})	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Without mulch	7.08	7.06	0.24	0.25	4.22	4.44	214.50	215.50	18.06	18.21	152.52	154.52
Bajra straw	6.65	6.60	0.17	0.19	5.32	5.52	225.25	226.75	18.81	19.43	158.69	160.94
Maize straw	6.57	6.42	0.18	0.20	5.84	6.06	229.50	231.00	19.06	19.83	163.18	164.31
Palah leaves (*Butea monosperma*)	6.81	6.40	0.17	0.20	5.12	5.32	222.00	224.25	18.46	19.12	155.33	156.45
Branker (*Adhotada vassica*)	6.68	6.60	0.20	0.21	6.10	6.24	233.00	234.50	19.21	20.18	165.99	167.11
Farmyard Manure	6.78	6.70	0.25	0.23	6.60	6.80	238.00	239.50	20.12	21.00	169.92	179.48
SEm ±	0.16	0.17	0.01	0.01	0.02	0.03	1.84	2.16	0.40	0.50	1.03	1.05
CD (p=0.05)	NS	NS	N.S.	N.S.	0.08	0.08	5.53	6.47	1.21	1.51	3.11	3.17

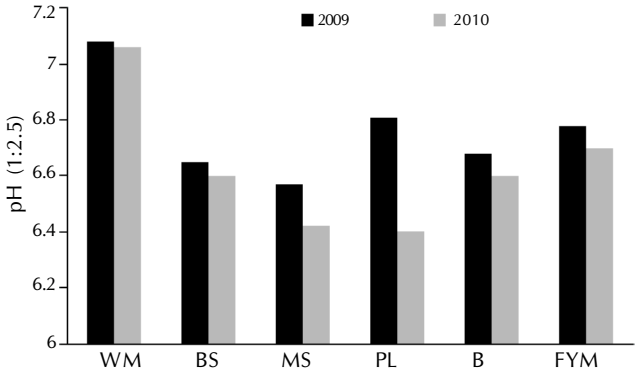

Figure1: Effect of organic mulches on the soil pH in 2009-2010

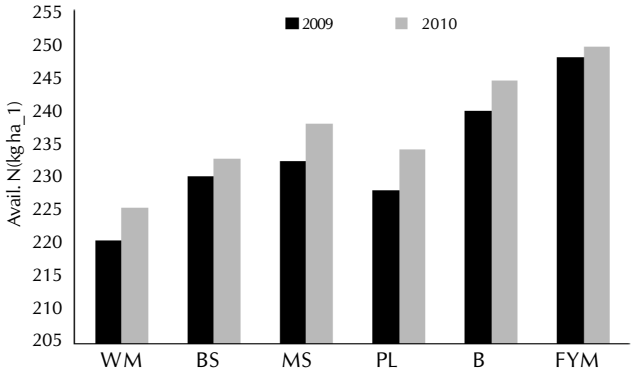

Figure 4: Effect of organic mulches on the Soil Available N (kg ha^{-1}) in 2009-2010.

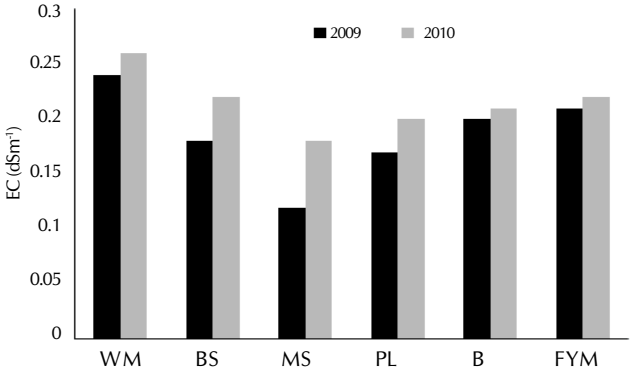

Figure 2: Effect of organic mulches on the Soil EC in 2009-2010

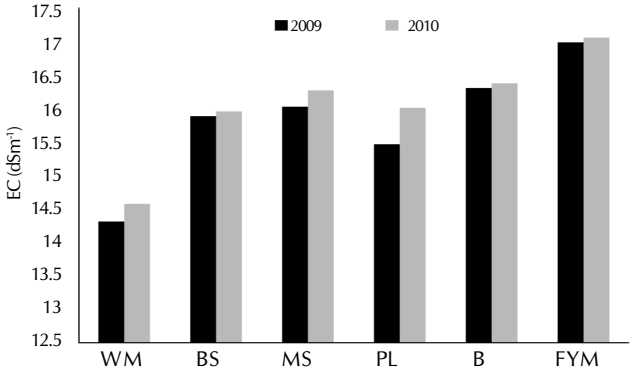

Figure 5: Effect of organic mulches on the Soil Available P (kg ha^{-1}) in 2009-2010

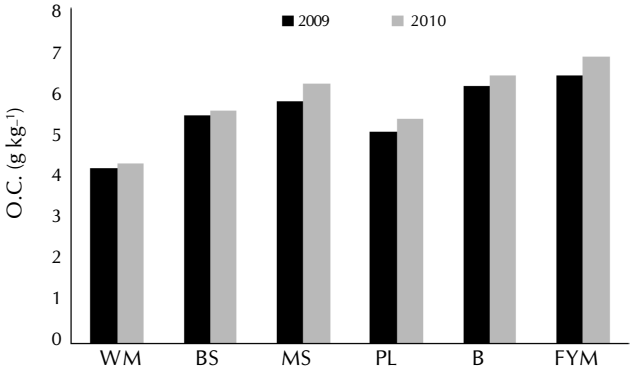

Figure 3: Effect of organic mulches on the soil O.C. (g kg^{-1}) in 2009-2010

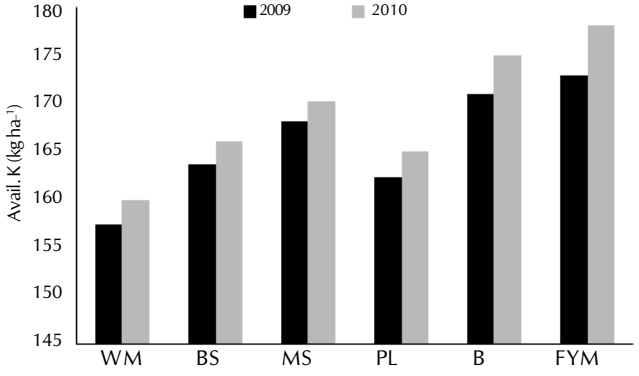

Figure 6: Effect of organic mulches on the Soil Available K (kg ha^{-1}) in 2009-2010

WM- without mulch, BS - bajra straw, MS - maize straw, PL - palah leaves, B - branker, FYM- farmyard manure. Significant at (p = 0.05, significant)

ammonification or leads to a shift in soil pH, which promotes the growth of the nitrifying bacteria population. Lowering of the nitrify activity and the consequent decrease of the NO^{-3}/ NH^{+4} ratio forces the crop to satisfy their nitrogen requirements by ammonium instead of nitrate. It is well known, that ammonium nutrition can interfere with the potassium uptake by direct antagonism or by a general reduction of the uptake of cations other than NH^{+4} (Gaiser *et al.,* 1992). Higher potential of nitrate leaching in mulched soil could not be overlooked because nitrate accumulation peak was found at deeper layer of mulched soil compared to no-mulched soil. Soil organic N mineralization is related to the environment (Gao *et al.,* 2009).

Soil available phosphorus Kg ha^{-1}(SAP Kg ha^{-1})

The result revealed that effect of different type of mulches on soil available phosphorus was significantly affect (p = 0.05) (Fig. 5.). The highest soil available phosphorus was observed in farmyard manure followed by brankad (*Adhotada vassica*), maize straw, bajra straw, palah leaves and lowest without mulch of tree basin both the years. As phosphorus

concentration in farmyard manure is higher than its concentration in soil, therefore irrigation or raining water can transfer phosphorus to soil layer. Whereas in other mulches, increasing mulch layer caused adjusting soil temperature and maintaining soil moisture that helped better phosphorus absorption condition in soil. Tree basin mulched with organic materials had significantly higher soil K concentrations than no mulched plots (Broschat, 2007). The organic acids produced during the decomposition of mulching materials complexes the metal cations Ca, Al and Fe, hereby helping in solubilization of native P and reduction in P sorption (Dahia and Malik, 2002). Potassium and phosphorus availability under mulch treatment increased in comparison with no-mulched treatment (Green lee and Rakow, 1995). The tendency of a higher amount of available phosphorus in the soil in mulched plots in 2009 to 2010 was established (Sinkeviciene *et al*., 2009).

Soil available potassium Kg ha^{-1} (SAK Kg ha^{-1})

Results showed that effect of different type of mulches on soil available potassium was significantly ($p = 0.05$) (Fig. 6.). The favourable effect of organic mulches on increasing the available plant nutrient content in the soil is well documented. The highest soil available potassium was observed in farmyard manure and lowest without mulch of tree basin both the years 2009-10. Organic mulches probably have much more potassium in their structure and with regulation of soil temperature and moisture helped to increasing soil available potassium. The potassium concentration in the plants in mulched plots was more than two times higher than in no-mulched plots. Higher K uptake in the mulched plots could be attributed to the higher K supply through the mulch material (Gaiser *et al*., 1992). They attributed this to K release during the decomposition of the mulch materials (Broschat, 2007). In one study potassium and phosphorus availability under mulch increased almost two times over the no-mulched, clean cultivated plots (Green Lee and Rakow 1995).

REFERENCES

Abouziena, H. F., Hafez, O. M., El-Metwally, I. M., Sharma, S. D. and Singh, M. 2008. Comparison of weed suppression and mandarin fruit yield and quality obtained with organic mulches, synthetic mulches, cultivation, and glyphosate. *Hort. Science.* **43 (3):** 795-799.

Broschat, T. K. 2007. Effects of mulch type and fertilizer placement on weed growth and soil pH and nutrient content. *Hort Technol*. **17(2):** 174-178.

Dahiya, R. and Malik, R. S. 2002. Trash and green mulch effects on soil N and P availability, www. www.tropentag.de/2002/proceedings/node19.htm. 2011-11-13.

Ferrini, F., Fini, A., Pellegrini, S., Agnelli, A., Platinetti, M., Frangi, P. and Amoroso, G. 2008. Effects of two organic mulches on soil chemical physical and biological properties. Proceedings of the 3rd symposium "The Landscape below Ground", Morton Arboretum, Lisle-IL, USA.

Gaiser, T., Stahr, K. and Kang, B. T. 1992. Mulching effect on P uptake by maize in a Ferrali-Haplic Nitosol in the subhumid tropics. Proceedings of the forth conference of the World Phosphate Institute, 8-11 September (1992), Ghent, Belgium. pp. 610-612.

Green Lee, K. M. and Rakow, D. A. 1995. The effect of wood mulch type and depth on weed and tree growth and certain soil parameters. *J. Arboricult.* **21(5):** 225-232.

Gao Y., Zhang J., Liu, W., Dang, Z., Cao, W. and Qiang, Q. 2009. Effects of mulch, N fertilizer, and plant density on wheat yield, wheat nitrogen uptake and residual soil nitrate in a dryland area of China. *Nutr Cycl Agroecosyst*. **85:** 109-121.

Hild, A. L. and Morgan, D. L. 1993. Effects on crown growth of five southwestern shrub species. *J. Environ. Hort*. **11(1):** 41-43.

Jodaugiene, D., Pupaliene, R., Sinkeviciene, A., Marcikeviciene, A., Zebrauskayte, K., Baltaduonyie M., Cepuliene R. 2010. The influence of organic mulches on soil biological properties. *Zemdirbyste-Agric*. **97(2):** 33-40.

Keramat, A., Marivani, B. and Samsami, M. 2011. Climatic change, drought and dust crisis in Iran. *World Academy of Sci. Eng. and Technol*. **57:** 10-13.

Lal, H., Samra, J. S. and Arora. Y. K. 2003. Kinnow mandarin in Doon Valley. 2. Effect of irrigation and mulching on water use, soil temperature, weed population and nutrient losses. *Indian Journal of soil Conservation.* **31(3):** 281-286.

Lagomarsino, A., Moscatelli, M. C., Di Tizio, A., Mancinelli, R., Grego, S. and Marinari, S. 2009. Soil biochemical indicators as a tool to assess the short-term impact of agricultural management on changes in organic C in a Mediterranean environment. *Ecological Indicator.* **9:** 518-527.

Rao, V. K. and Pathak, R. K. 1998. Effect of mulches on Aonla (*Emblica Officinalies Gaertn*) orchard in sodic soil. *Indian Journal of Horticulture.* **55(1):** 27-32.

Shirugure, P. S, Sonkar, R. K., Singh, S. and Panighrah, P. 2003. Effect of different mulches on soil moisture, weed reduction, growth and yield of drip irrigated Nagpur mandarin (*Citrus reticulata*). *Indian Journal of Agricultural Sciences.* **73:**148-52.

Shirugure, P. S., Singh, S., Panighrah, P. and Sonkar, R. K. 2005. Evaluation of mulches for improving bearing acid lime. *Indian Journal of Soil Conservation.* **33(1):** 62-66.

Sinkevièienë, A., Jodaugienë, D., Pupalienë, R., Urbonienë, M. 2009. The influence of organic mulches on soil properties and crop yield. *Agron. Res*. **7:** 485-491.

Slathia, P. S. and Paul, N. 2012. Traditional practices for sustainable livelihood in Kandi belt of Jammu. *Indian Journal of Traditional Knowledge*. **11(3):** 548-552.