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Damor VG
Agri. Officer, Govt. of Gujarat, Gujarat, India

Kharadi RR
Assistant Professor, Lokbharti University, Sanosara, Gujarat, India

Patel RB
Prof. & Head, Dept. of Soil science and agril. chem., AAU, Anand, Gujarat, India

Correspondence
Damor VG
Agri. Officer, Govt. of Gujarat, Gujarat, India

Influence of herbicides applied with or without manures on chemical properties of soil in pearl millet

Damor VG, Kharadi RR and Patel RB

Abstract
The field experiment was carried out on the "Effect of herbicides applied with and without manures on chemical properties of soil in pearl millet (*Pennisetum glaucum* L.)" during *summer* season of the year 2011-12. Among manures, FYM was applied @ 10 t ha^{-1} and vermicompost applied @ 3 t ha^{-1} and compared with no manure (Control). atrazine was applied @ 500 and 1000 g ha^{-1} and oxyflourfen applied @ 80 and 100 g ha^{-1} as pre-emergence and compared with interculturing (IC) *fb* hand weeding (HW) carried out at 20 and 40 DAS (non-chemical control). Organic carbon content, total N and available P_2O_5 of soil were significantly higher recorded with the application of FYM @ 10 t ha^{-1} at one and 30 DAS which was at par with application of vermicompost @ 3 t ha^{-1}. Significantly higher available K_2O content was recorded with the addition of vermicompost @ 3 t ha^{-1} and was at par with application of FYM @ 10 t ha^{-1} at one and 30 DAS.

Keyword: manures, herbicides, soil properties, pearl millet

1. Introduction
Pearl millet (*Pennisetum glaucum* L.) is the most widely grown type of millet which is originated in Africa and introduced in India since prehistoric times. Pearl millet is the fourth most important food grain crop in India after rice, wheat and sorghum and ranked sixth in the world following wheat, rice, maize, barley and sorghum. Cultivation of pearl millet is mainly follow during *kharif* season across the country. India ranks first both in production and an area of pearl millet. In India, it is cultivated over an area of 9.1 million hectares with a production of 9.5 million tones with the productivity of 1044 kg ha^{-1}. It is generally grown in areas of low rainfall and in poor soils.

Summer pearl millet is popular in Gujarat State with very high yield exceeding 2276 kg ha^{-1} during 2009-10 with excellent grain quality. It is also grown during summer season in Punjab, Rajasthan and Andhra Pradesh. The yield of pearl millet varies from state to state with varying rainfall and soil type and also between seasons. The productivity imbalance in pearl millet is due to erratic rains or shifting of pearl millet cultivation on marginal soils due to diversification of traditional area to high value crops across the country. It is cultivated over an area of 4.8 lakh ha in Gujarat. The total production of pearl millet in Gujarat state is 4.880 lakh tones and the productivity is 998 kg ha^{-1} (Anon., 2011) [1].

Weed is generally defined as any unwanted plant in the field. Weed management is one of the main constraints in achieving desired yield as the weeds have better competing ability than the main crop. Moreover, they can survive in adverse conditions. The weeds compete with the crop for moisture, nutrients, space, light and so on as a result of which the crop suffers from weed infestation.

The magnitude of crop yield loss due to weed infestation was estimated more than 55 per cent depending on composition of weed flora, period of crop-weed competition and its intensity (Banga *et al*. 2000) [2]. Hence for keeping weeds under check and boosting the production, herbicides such as atrazine is widely and successfully employed in pearl millet crop. Oxyflourfen is also recommended for weed management in pearl millet as pre-emergence. Ideally, herbicide should control or eradicate the target species selectively in ecosystem, remain active at the site of application for desired period and degrade rapidly once its purpose is achieved. In soil, the effectiveness of herbicide is measured in terms of its persistence. It should persist long enough to control the weeds during crop-weed competition and at the same

time it should not persist to the extent that it is toxic to the succeeding crop.

Incorporation of farm yard manure or vermicompost is an effective method to mitigate the residual toxicity of herbicide. Application of farm yard manure or compost helps to absorb the herbicide molecule in their colloidal fraction and make them unavailable for crops and weeds. Beside, incorporation of farm yard manure or vermicompost enhances the microbial activity, which in turn degrades the herbicides rapidly and effectiveness of herbicide is less achieved at a faster rate due to more microbial activities in soils.

2. Material method

The field experiment was carried out at AICRP on Weed Control Farm, B.A. College of Agriculture, Anand Agricultural University, Anand on the Influences of herbicides applied with or without manures on "plant growth as well as grain and straw yield and protein content of summer pearl millet" during summer season of the year 2011-12.the experiment was laid out Randomized Block Design (Factorial) with No. of treatments 15.among Organic manure, farm yard manure was applied @ 10 t ha^{-1} and 3 t vermicompost ha^{-1} and compared with no manure(control). Weed Management H_1: Atrazine @ 500 g ha^{-1} as pre emergence, H_2: Atrazine @ 1000 g ha^{-1} as pre emergence, H_3: Oxyflourfen @ 80 g ha^{-1} as pre emergence, H_4: Oxyflourfen @ 100 g ha^{-1} as pre emergence, H_5: IC *fb* HW at 20 and 40 DAS (Non chemical control). Estimation of pH and EC at 25°C (dSm^{-1}) (1:2.5) method by jackon. Organic carbon (%) method adopted Walkley & Black method. Total nitrogen content (%) method adopted Kjeldahl's digestion method. Available P_2O_5 (kg ha^{-1}) method adopted Olsen's Method. Available K_2O (kg ha^{-1}) method adopted Flame photometry.

3. Result and discussion

Effect of manures on EC of soil

The data showed on TABLE: 1 Influence of manures and herbicides on soil EC are revealed that soil electrical conductivity analyzed at one and 30 DAS and at harvest was not significantly influenced by application of FYM or vermicompost. Similarly, in a long-term study with wheat-*bajra* rotation did not find remarkable changes in soil EC by the application of 15 t FYM ha^{-1} in a sandy loam soil at Hisar. Rathod (2003) [8] also did not find any significant changes in soil EC on application of FYM @10 t ha^{-1} under similar soil conditions.

Effect of herbicides on EC of soil

A perusal of data given TABLE: 1 that the difference in electrical conductivity of the soil at all the intervals was statistically found to be non-significant. A gradual decreasing trend was observed at 30 DAS which might be due to movement of inherent salts or salts presents in irrigation water or salts formed due to neutralization of fertilizers applied as top dressing. Meena (2009) [4] also did not find any significant change in EC on application of herbicides on soil under chickpea crop.

Effect of manures on soil pH

A perusal of data given TABLE: 1 all the intervals, the differences in soil pH due to application of FYM or vermicompost were observed to be non-significant. However, slightly less soil pH was estimated with the application of 3 t vermicompost ha^{-1}. This might be due to release of carbonic acid during decomposition of organic matter. The maintenance of soil pH nearer to neutral condition in plots receiving vermicompost may be attributed to enhanced buffering capacity of soil due to addition of organic matter. In the present investigation addition of vermicompost helped in restoring soil pH nearer to neutral range. Under alkaline soil condition, Rathod (2003) [8] did not find change in soil pH due to application of FYM.

Effect of herbicides on soil pH

A perusal of data given TABLE: 1 results revealed that there were non-significant differences in soil pH under various applications of herbicide at all the intervals. However, little higher soil pH was recorded with application of herbicides at almost all the intervals. The results are in conformity with the findings of Rathod (2003) [8] who did not show significant changing in soil pH due to application of dinitroaniline herbicides under mustard crop.

Effect of manures on organic carbon of soil

A data presented on TABLE: 1 evident from incorporation of FYM @ 10 t ha^{-1} and vermicompost @ 3 t ha^{-1} increased the organic carbon of soil. Organic carbon of soil analysed at one and 30 DAS was significantly higher found with the incorporation of FYM @ 10 t ha^{-1} in soil which was at par with the incorporation of vermicompost @ 3 t ha^{-1} under pearl millet crop. It has been well documented that the organic matter is converted to their basic organic components by the extra cellular enzymes produced by heterotrophs and these simple compound are used by other microbes for their body building process. The decomposition of microbial bodies thus, enriches the soil with organic carbon. Later stages organic carbon is utilized by crop for vegetative growth, hence a difference in organic carbon is found non-significantly at harvest. These results of increment in organic carbon status are in agreement with the findings of Gaikwad *et al.* (2011) [3] who also reported that the addition of FYM or vermicompost helped in improvement of organic carbon of soil.

Effect of herbicides on organic carbon of soil

The average organic carbon of soil decreased in herbicidal treatments while, increased in non-chemical IC *fb* HW carried out at 20 and 40 DAS treatment with time. The data showed that the differences in organic carbon of soil among the herbicidal treatments at all the intervals were seemed to be non-significant. Results obtained in the present study revealed that herbicides had no influence on the organic carbon of soil at various intervals. These results are in conformity with the findings of Rathod and Patel (2003) [7] also did not find significant difference in organic carbon of soil under different herbicidal treatments in mustard field.

Effect of manures on total nitrogen of soil

The results data presented: 2 furnished revealed that total nitrogen status significantly affected due to incorporation of farm yard manure and vermicompost. Significantly higher total nitrogen of soil was recorded with the addition of FYM @ 10 t ha^{-1} which was at par with incorporation of vermicompost applied @ 3 t ha^{-1} in soil at one DAS while higher total nitrogen of soil was observed in the application of FYM @ 10 t ha^{-1} but the differences in total nitrogen of soil were not significant at 30 DAS and at harvest. This result is in agreement with the findings of Patel (2002) [5].

Table 1: Effect of herbicides with or without manures and their properties of ec, ph, organic carbon content of pearl millet

Treatments	Sampling periods (EC)			Sampling periods (pH)			Sampling periods (ORGANIC CARBON)		
	One DAS	30 DAS	At Harvest	One DAS	30 DAS	At Harvest	One DAS	30 DAS	At Harvest
Manure (M)									
M_0: control (No manure)	0.24	0.24	0.32	8.05	8.19	8.13	0.32	0.34	0.35
M_1: 10 t FYM ha^{-1}	0.23	0.22	0.33	8.02	8.17	7.98	0.41	0.38	0.34
M_2: 3 t vermicompost ha^{-1}	0.22	0.23	0.31	7.83	8.10	8.10	0.38	0.36	0.36
S.Em. ±	0.007	0.008	0.012	0.09	0.08	0.08	0.011	0.012	0.014
C.D. at 5 %	NS	NS	NS	NS	NS	NS	0.031	0.031	NS
Herbicides (H)									
H_1: Atrazine @ 500 g ha^{-1} as pre emergence	0.24	0.23	0.31	7.98	8.23	8.11	0.37	0.35	0.32
H_2: Atrazine @ 1000 g ha^{-1} as pre emergence	0.23	0.22	0.30	7.91	8.19	8.17	0.39	0.37	0.33
H_3: Oxyflourfen @ 80 g ha^{-1} as pre emergence	0.24	0.23	0.31	8.23	8.25	8.14	0.38	0.36	0.37
H_4: Oxyflourfen @ 100g ha^{-1} as pre emergence	0.23	0.22	0.32	7.90	8.02	7.99	0.39	0.35	0.34
H_5: IC *fb* HW at 20 and 40 DAS (Non chemical control)	0.23	0.22	0.32	7.91	8.07	8.05	0.37	0.37	0.39
S.Em. ±	0.009	0.007	0.016	0.12	0.11	0.11	0.019	0.016	0.018
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS
C V %	11.8	9.3	15.1	4.6	4.2	4.1	10.3	13.4	15.2

Effect of herbicides on total nitrogen of soil

A perusal of data given TABLE: 2 results revealed that total nitrogen of soil was not significantly affected due to application of different herbicidal treatments. Total nitrogen of soil was recorded higher with the IC *fb* HW carried out at 20 & 40 DAS (Non-chemical control) at one and 30 DAS and at harvest. The lower total nitrogen in soil was found under the pre-emergence application of oxyflourfen @ 100 g ha $^{-1}$ at one and 30 DAS and at harvest, but all the differences were found non-significant.

Effect of manures on available P_2O_5 of soil

A perusal of data given TABLE: 2 results furnished revealed that available soil phosphorus status significantly affected due to incorporation of farm yard manure or vermicompost. Significantly higher available P_2O_5 was recorded with the addition of FYM @ 10 t ha^{-1} which was at par with incorporation of vermicompost @3 t ha^{-1} in soil at one and 30 DAS as well as at harvest. Gaikwad *et al.* (2011) [3] also found higher available P_2O_5 in sandy loam soil with the application of FYM or vermicompost over control.

Effect of herbicides on available P_2O_5 of soil

It is seen from the data that TABLE: 2 the available phosphorus of soil at various sampling intervals numerically decreased under herbicidal treatments as compared to interculturing and hand weeding treatment but the differences were found to be non-significant. This result is in agreement with the finding of Meena (2009) [4].

Effect of manures on available K_2O of soil

A data presented on given TABLE: 2 the results furnished revealed that available K_2O of soil significantly affected due to incorporation of farm yard manure and vermicompost. Signficantly higher available K_2O of soil was recorded with the addition of vermicompost @ 3 t ha^{-1} and was at par with application of FYM @ 10 t ha^{-1} at one and 30 DAS. While available K_2O of soil was not significantly influenced by manures at harvest. This result is in closely agreement with the findings of Rajkhowa *et al.* (2003) [6].

Effect of herbicides on available K_2O of soil

A data represented on TABLE: 2 presented revealed that the herbicidal treatments did not exert any significant influence on available K_2O of the soil at all the sampling intervals. But available K_2O of soil was higher in the IC *fb* HW carried out at 20 & 40 DAS (Non-chemical control) treatment as compared to the herbicidal treatments.

Table 2: Effect of herbicides with or without manures and their soil Properties of total n, avail.p_2o_5, k_2o content of pearl millet

Treatments	Sampling periods (Total N)			Sampling periods (Avail P_2O_5)			Sampling periods (K_2O)		
	One DAS	30 DAS	At Harvest	One DAS	30 DAS	At Harvest	One DAS	30 DAS	At Harvest
Manure (M)									
M_0: control (No manure)	558.92	657.44	658.57	54.10	56.52	59.30	232.22	227.99	224.50
M_1: 10 t FYM ha^{-1}	708.78	701.19	694.86	82.15	64.42	83.25	275.32	263.48	235.99
M_2: 3 t vermicompost ha^{-1}	693.94	669.64	669.22	79.68	61.48	78.46	281.63	273.55	236.41
S.Em. ±	26.90	21.52	20.98	2.37	1.47	2.71	4.56	4.64	4.45
C.D. at 5 %	77.92	NS	NS	6.87	4.26	7.84	13.20	13.44	NS
Herbicides (H)									
H_1: Atrazine @ 500 g ha^{-1} as pre emergence	662.92	657.28	656.55	70.22	60.25	71.22	259.83	269.61	263.39
H_2: Atrazine @ 1000 g ha^{-1} as pre emergence	652.70	699.68	689.72	68.80	60.10	67.70	264.87	272.08	273.67
H_3: Oxyflourfen @ 80 g ha^{-1} as pre emergence	649.90	665.72	664.78	75.01	61.51	76.04	266.71	269.19	268.04
H_4: Oxyflourfen @ 100g ha^{-1} as pre emergence	638.70	654.36	654.97	74.70	60.91	74.62	250.49	264.39	257.66
H_5: IC *fb* HW at 20 and 40 DAS (Non chemical control)	665.19	703.40	705.06	75.16	63.25	76.80	273.40	283.08	272.73
S.Em. ±	34.73	27.78	27.09	3.06	1.90	3.49	5.88	5.99	5.75
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS
C V %	15.9	12.3	12.0	12.8	9.4	14.2	6.7	6.6	6.4

4. Conclusion

Physical properties of soil viz; electrical conductivity, pH not significantly influenced by application of manures at 30 DAS and at harvest. Organic carbon content, total N and available P_2O_5 of soil were significantly higher recorded with the application of FYM @ 10 t ha^{-1} at one and 30 DAS which was at par with application of vermicompost @ 3 t ha^{-1}. Significantly higher available K_2O content was recorded with the addition of vermicompost @ 3 t ha^{-1} and was at par with application of FYM @ 10 t ha^{-1} at one and 30 DAS. No other soil properties were significantly affected by manures. Physical properties viz; pH, electrical conductivity, organic carbon, total nitrogen; available P_2O_5, K_2O were not significantly influenced by application of herbicides of soil.

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