Biological Forum – An International Journal 15(3): 78-84(2023)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Assessing Effect of Weed management Practices on Physical Soil properties in An Acid Alfisol of Western Himalayas

*Neha Chauhan[1], Sanjay K. Sharma[2], S.S. Rana[3], Naveen Datt[4], Pardeep Kumar[4], Shabnam[5], Sakshi Vishvamitera[6], Deeksha Choudhary[6], Brij Vanita[7], Shivani Thakur[8], Gaytri Hetta[9], Sarwan Kumar[9] and Nikhil Chauhan[10]**

[1]SMS (Soil Science), Krishi Vigyan Kendra Mandi at Sundernagar, CSKHPKV Palampur (Himachal Pradesh), India.
[2]Professor, Department of Soil Science, CSKHPKV Palampur (Himachal Pradesh), India.
[3]Principal Scientist, CSK Himachal Pradesh Agricultural University, Palampur (Himachal Pradesh), India.
[4]Principal Scientist, Department of Soil Science, CSKHPKV Palampur (Himachal Pradesh), India.
[5]Assistant Professor (Soil Science), College and Horticulture and Forestry, Thunag, Mandi, YSPUHF Solan (Himachal Pradesh), India.
[6]Ph.D. Scholar, Department of Soil Science, CSKHPKV Palmapur (Himachal Pradesh), India.
[7]SMS (Vet & AH) Krishi Vigyan Kendra Mandi at Sundernagar, CSKHPKV Palampur (Himachal Pradesh), India.
[8]SMS (Agrometerology), Krishi Vigyan Kendra Mandi at Sundernagar, CSKHPKV Palampur (Himachal Pradesh), India.
[9]Ph.D. Scholar, Department of Agronomy, CSKHPKV Palampur (Himachal Pradesh), India.
[10]Ph.D. Scholar, Department of Plant Pathology, YSPUHF Solan (Himachal Pradesh), India.

(Corresponding author: Nikhil Chauhan)*
(Received: 14 January 2023; Revised: 16 February 2023; Accepted: 20 February 2023; Published: 22 March 2023)
(Published by Research Trend)

ABSTRACT: An experiment on weed management was initiated from *kharif* 2019 to *rabi* 2020-21 in a maize– pea cropping system at the Experimental Farm of Department of Agronomy, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur under the network of All India Coordinated Research Project on weed management since 2016. There were ten treatments *viz.* (T_1: Hoeing; T_2: SSB + Hoeing; T_3: RSSB + Hoeing; T_4: Mulching; T_5: SSB + Mulching; T_6: RSSB + mulching; T_7: intercropping; T_8: crop rotation; T_9: intensive cropping and T_{10}: chemical check) which were duplicated three fold in a randomized block design. The soil physical parameters *viz.* were analysed using standard analytical method. Among physical soil properties, the bulk density and particle density value was recorded highest in the chemical check (T_{10}) and lowest in the treatment RSSB + Mulch (T_6), whereas the properties *viz.* porosity, water holding capacity, saturated hydraulic conductivity, mean weight diameter recorded the highest values in the treatment RSSB + mulch (T_6) followed by intercropping (T_7) and the lowest values were observed in chemical check (T_{10}).

Keywords: weed management, mulching, stale seed bed, physical properties, intensive cropping.

INTRODUCTION

Concerning the evil impacts of chemical farming, presently the pattern have changed to organic farming and there is an arising awareness among public on consuming natural produces (Jeeva *et al.*, 2020) Notwithstanding, the organic production system is defenseless against biotic and abiotic stress. Among biotic stress, weeds cause 45% yield misfortune (Rao 1993). Thus, dealing with the weeds during the basic time of weed rivalry prompts improved productivity. Several weed management practices such as hoeing, stale seed bed, raised stale seed bed, mulching, intercropping through inclusion of legumes, intensive cropping, manuring, residue management were discovered to have a significant impact on the cycle of nutrients and the turnover of organic material. In addition to producing low yields, improper and imbalanced fertilizer and pesticide use also degrades soil fertility and worsens several nutrient deficits. It is generally known that organic weed control has been effective in boosting crop yields and maintaining the quality and health of the soil. One weed control strategy that has the potential to cut down on labor costs and human labour is the use of stale seed beds (Senthilkumar *et al.*, 2019). For plants to grow and flourish in soil, it's vital to have certain physical soil attributes. Physical soil quality indices are essential for determining soil productivity and are permanent elements of soil quality evaluation (Karlen and Cambardella 1996). Physical parameters of soil dictate the varying soil functions (Wagnet and Hutson 1997). The physical properties provide the physical support to the plant and are important for overall assessment of soil health. Kumar *et al.* (2018) conducted an experiment at Kumarganj to study the effect of weed management practices on soil bulk density after the harvest of blackgram and the results showed that the hand weeding recorded the lowest value of bulk density as compared to herbicide treated plot but the differences were non-significant. Acharya *et al*. (1998) conducted an experiment in Palampur (H.P.) to study the effect of lantana mulching on soil bulk density and they reported that there was an increased earthworm activity in lantana-treated plots, which also lowered the bulk density of soil. Sahoo *et al.* (2021) conducted an experiment at Samastipur, Bihar to study soil physicochemical properties as affected by organic weed management and they found that the mulched plots showed a higher water holding capacity over the weed-free and unweeded control. Kumar *et al.* (2020) at Kumarganj reported that non-significant response was observed with respect to herbicides application on soil bulk density. Modak *et al.* (2019) conducted an experiment on the effect of weed management on bulk density and the results revealed that various weed management practices failed to influence bulk density values significantly. Meshram *et al.* (2019) conducted an experiment to study the effect of weed management on hydraulic conductivity of soil after the harvest of soybean and they found that weed management treatments didn't show any significant effect on hydraulic conductivity of soil. A study was conducted by Patel *et al.* (2020) at Kumarganj, to study the effect of weed management practices on bulk density and they found that no significant difference were observed due to effect of weed management practices on the bulk density

The effect of different weed management practices on soil physical properties is very crucial. Consequently, the current investigation was undertaken in an AICRP on weed management to investigate the impact of weed management practices on physical soil properties in maize–pea cropping system.

MATERIAL AND METHOD

A field experiment was conducted for consecutive two years during *kharif* 2019 to *rabi* 2020-21 under the aegis of **All India Coordinated Research Project on Weed Management** (AICRP-WM) that was initiated in *kharif* 2016 in a maize–pea sequence at the Experimental Farm of Department of Agronomy, Forages and Grassland Management, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya, Palampur. The experimental farm is 1290 meters above mean sea level and is located at 32° 6° N latitude and 76° 3° E longitude. The experimental site has a wet-temperate environment with warm summers and cold winters. The soil in the studied area belongs to the taxonomic group "Typic Hapludalf" and "Alfisol." It has a silty clay loam texture and acidic in reaction. Ten treatments were used in the randomized block design (RBD) trial.

Soil sampling. Plot-wise composite soil samples (0–15-cm depth) were collected from each plot after harvest of maize and pea crop (2019–2020 and 2020–2021). The soil samples were passed through 100-mesh screen and were stored in polythene bags for determining different soil physical properties.

Treatment details.

Treatment	*kharif* (Maize green cob)	*rabi* (Peas)	Short title
T_1	One hoeing followed by earthing up at knee high stage	Hoeing (twice) at 30 DAS and 60 DAS	Hoeing
T_2	Stale seed bed (SSB) + hoeing + earthing up	SSB + hoeing + HW	SSB + hoeing
T_3	Raised stale seed bed (RSSB)+ hoeing + earthing up	RSSB + hoeing + HW	RSSB + hoeing
T_4	Mulch (*Lantana*) @ 5 t ha^{-1}	Mulch (*Lantana*)@ 5 t ha^{-1}	Mulch
T_5	SSB + mulch @ 5 t ha^{-1}	SSB + mulch @5 t ha^{-1}	SSB + mulch
T_6	RSSB + mulch @ 5 t ha^{-1}	RSSB + mulch @ 5 t ha^{-1}	RSSB + mulch
T_7	Intercropping (soybean) + hoeing	Intercropping (fenugreek) + hoeing	Intercropping
T_8	*Maize/Soybean + hoeing+ earthing up	*Pea/Mustard + hoeing+ HW	Crop rotation
T_9	**Mulch + manual weeding *fb* autumn crop of Mustard	**Mulch + manual weeding *fb* summer crop of buckwheat	Intensive cropping
T_{10}	RDF + Chemical check (Atrazine 1.0 kg ha^{-1} + HW)	RDF + Chemical check (Pendimethalin 1.0 kg ha^{-1} + HW)	Chemical check

Analysis of soil samples.

Parameter	Method employed	Reference
Physical Parameters		
Bulk Density	Core sampler method	Singh (1980)
Particle Density	Pycnometer method	Gupta and Dhakshinamoorthy (1980)
Porosity	Empirical method	Gupta and Dhakshinamoorthy (1980)
Water holding Capacity	Keen moisture box method	Piper (1950)
Mean weight Diameter	Wet sieving method	Yoder (1936)
Saturated hydraulic conductivity	Constant head method	Klute (1965)

Statistical analysis. The obtained data were statistically analyzed using the randomized block design technique for analysis of variance in order to interpret the findings using accepted practices as outlined by Gomez and Gomez (1984).

RESULT AND DISCUSSION

Effect of weed management practices on soil bulk density (Mg m^{-3}). Data pertaining to bulk density of soil as affected by weed management practices after the harvest of maize-pea (2019-20 & 2020-21) have been presented in Table 1. Data in the Table 1 revealed significant variation in bulk density of soil due to various weed management practices during the course of study. It was observed that after each cropping sequence, a small reduction in the bulk density of soil was recorded due to various weed management practices. In the first year after maize –pea cropping system (2019-20) the bulk density of surface soil (0 - 0.15 m) ranged from a minimum value of 1.25 Mg m^{-3} in RSSB + mulch (T_6) to maximum value of 1.33 Mg m^{-3} in chemical check (T_{10}). Application of lantana mulch alone (T_4) or in combination with SSB (T_5) and RSSB (T_6) decreased the bulk density of soil to the extent of 2.32, 3.87 and 4.65 per cent, respectively, over Hoeing (T_1). In sub-surface soil, bulk density was recorded lowest in RSSB + mulch (T_6) followed by SSB + mulch (T_5) and the highest was recorded in chemical check (T_{10}). The bulk density recorded after each season was found slightly higher in sub-surface soil (0.15 - 0.30 m) as compared to surface soil (0 - 0.15 m) and treatment wise trend was similar as that of surface soil.

In the second year after *rabi* 2020-21 bulk density of surface soil (0 - 0.15 m) ranged from a minimum value of 1.25 Mg m^{-3} in RSSB + mulch (T_6) to maximum value of 1.33 Mg m^{-3} in chemical check (T_{10}). Application of lantana mulch alone (T_4) or in combination with SSB (T_5) and RSSB (T_6) decreased the bulk density of soil to the extent of 3.14, 3.93 and 4.68 per cent, respectively, over hoeing (T_1). In sub-surface soil, bulk density was recorded lowest in RSSB + mulch (T_6) followed by SSB + mulch (T_5) and the highest was recorded in chemical check (T_{10}). The bulk density recorded after each season was found slightly higher in sub-surface soil (0.15 - 0.30 m) as compared to surface soil (0 - 0.15 m) and treatment wise trend was similar as that of surface soil.

The lowest bulk density was recorded in mulch plots which may be due to the soil's higher organic matter content and increased microbial activity, which improves soil aggregation. The soil aggregates produced by applying organic manures have the most pore space of any soil aggregation. Such pore space distribution decreases soil bulk density and increases soil porosity by lowering soil weight per unit volume of soil. Sharma and Acharya (2000); Bhushan and Sharma (2005); Das *et al.* (2016) also reported that bulk density of mulch treated plots was significantly lower. Furthermore, organic material addition raises soil macropores while lowering meso- and micropores, which ultimately results in a reduction in soil bulk density. Although there was little change in soil bulk density in the current study, it provided evidence that organic components were important or had an impact on soil bulk density. The current findings are highly consistent with the findings of Brar *et al.* (2013); Brown and Cotton (2011) who reported that the use of various organic mulches in soils reduced the soil bulk density. The highest soil bulk density was recorded in chemical check which may be due to low organic matter content in soil and formation of compact layer. As compared to chemical check, hoeing treatment recorded lower value of bulk density. Kumar *et al.* (2020) also reported that compared to a herbicide-treated plot, manual weeding and hoeing recorded a lower bulk density value, but the changes were not statistically significant. The increase in root and plant biomass and the transformation of some micropores into macropores due to the cementing action of organic acids and polysaccharides formed during the decomposition of organic residues by higher microbial activities may be the causes of the decrease in bulk density over time (Pant and Ram 2018). The comparatively lower bulk density was recorded in surface soil as compared to sub-surface which may be due to frequent cultivation of land which made the soil loose and ultimately contributed to the lower density in surface layer as compared to sub-surface layer. The high bulk density in the sub-surface layer indicated the presence of compacted sub-surface layer. Modak *et al.* (2019); Kundu *et al.* (2020) concluded that various weed management practices failed to influence bulk density values significantly.

Effect of weed management practices on soil particle density (Mg m^{-3}). The data on particle density of soil as affected by different weed management practices have been presented in Table 1. It is evident from the data that weed management treatments had non-significant effect on particle density at surface (0 - 0.15 m) as well as sub-surface soil (0.15 - 0.30 m). In the first year the particle density varied between 2.52 to 2.60 Mg m^{-3} in surface soil to 2.60 to 2.69 Mg m^{-3} and in the second year, particle density varied between 2.50 to 2.58 Mg m^{-3} in surface soil to 2.58 to 2.68 Mg m^{-3}.It was evidenced from the data in the table that the particle density value in all the cropping season was lower in treatments where lantana mulch was applied as compared to other treatments although the treatments were statistically at par with each other. Bhatt *et al.* (2017) reported that particle density (PD) did not changed significantly over a period of twenty-nine years due to continuous addition of organic manure. The sub-surface soil recorded comparatively greater values of particle density as compared to surface soil. With the cropping season the small reduction in particle density value was recorded.

Effect of weed management practices on soil porosity (%). The data pertaining to the effect of weed management practices on porosity of soil after each season have been presented in Table 1. It is evident from the data presented in table that the soil porosity differed significantly during all the cropping season. During first year, the porosity of soil ranged from 49.38 to 52.67 per cent in surface soil and 48.36 to 51.87 per cent in sub-surface soil in different treatments and during second year the porosity of soil ranged from 49.94 to 53.88 per cent in surface soil and 48.92 to 52.45 per cent in sub-surface soil in different treatments. A critical examination of data in Table 1 indicated that during both years the highest value of soil porosity was found in the treatment comprising RSSB + mulch (T_6) whereas, lowest value was recorded in the treatment chemical check (T_{10}). It is evident from the data given in table that the treatments where lantana mulch was applied resulted in significantly high value of soil porosity as compared to rest of the treatments. Stale seed bed and raised stale seed bed in combination with hoeing resulted in higher value of soil porosity as compared to hoeing alone although the treatments were statistically at par with each other. Treatment intercropping accounted for higher value of soil porosity as compared with crop rotation and intensive cropping although the treatments were statistically at par with each other. The lowest value of soil porosity was recorded in chemical check. The lower values of soil porosity were recorded in sub-surface soil as compared to surface soil and treatment wise trend was similar as observed in case of surface soil.

Effect of weed management practices on soil water holding capacity (%). It is evident from the data presented in Table 2 that the water holding capacity differed significantly during all the cropping season. During first year, the water holding capacity of soil ranged from 50.1 to 59.3 per cent in surface soil and 46.2 to 53.8 per cent in sub-surface soil in different treatments and during second year the water holding capacity of soil ranged from 51.5 to 59.7 per cent in surface soil and 47.7 to 54.2 per cent in sub-surface soil in different treatments.

A critical examination of data in Table 2 indicated that during both the years the highest value of water holding capacity in surface soil was found in the treatment comprising RSSB plus mulch whereas, the lowest value was recorded in the treatment chemical check. It is evident from the data given in table that the treatments where lantana mulch was applied resulted in significantly high value of water holding capacity as compared to rest of the treatments. Stale seed bed and raised stale seed bed in combination with hoeing resulted in higher value of soil porosity as compared to hoeing alone although the treatments were statistically at par with each other. Treatment intercropping accounted for higher value of soil porosity as compared to crop rotation and intensive cropping although the treatments were statistically at par with each other. The lowest value of soil porosity was recorded in chemical check. The lower values of soil porosity were recorded in sub-surface soil as compared to surface soil and treatment wise trend was similar as observed in case of surface soil. Kundu *et al.* (2020) reported use herbicides had no significant influence on soil water holding capacity (WHC).

The higher soil water holding capacity was recorded in RSSB + mulch treatment which might be due addition of mulch biomass in soil and favourable plant growth conditions to Sahoo *et al.* (2021) reported that the mulched plots showed a higher WHC over unweeded control. While mulch application on the top increased the amount of organic carbon in the soil, the higher WHC in the subsurface layers may have resulted from increased root biomass brought on by FYM or inorganic fertilizers (Pant and Ram 2018; Rasool *et al.,* 2008; Bhatt *et al.,* 2017). The addition of manure, FYM, vermicompost and mulch in soils improved the soil structure, increased soil aggregation, number of micro and macro-pores and thus increase the water-holding capacity (Subhan *et al.,* 2017; Abid *et al.,* 2020). The soil's ability to store more water was improved by the addition of organic matter (Bhatt *et al.*, 2017).

Effect of weed management practices on soil saturated hydraulic conductivity (SHC). Saturated hydraulic conductivity is a quantitative measure of a saturated soil's ability to transmit water when subjected to a hydraulic gradient. It can be thought of as the ease with which pores of a saturated soil permit water movement. It is one of the most important soil physical properties for determining infiltration rate, irrigation and drainage practices and other hydrological processes and plays a key role in evaluating the potential use of soil for many agricultural and non-agricultural uses**.** Hydraulic conductivity is a vital hydrological parameter and it is very essential for soil water management practices.

The data on saturated hydraulic conductivity as influenced by different weed management practices have been presented in Table 2. It can be conjunctured from data in the Table 2 that during first year the SHC values varied from 1.27 to 1.58 cm hr^{-1} in the surface soil samples (0–0.15 m) and 1.19 to 1.43 cm hr^{-1} for the samples at 0.15–0.30 m soil depth and during second year the saturated hydraulic conductivity ranged from 1.32 to 1.62 cm hr^{-1} in surface soil to 1.23 to 1.49 cm hr^{-1} in sub-surface soil. The highest value during the period under study was observed in RSSB + mulch (T_6) treatment which was statistically at par with SSB + mulch (T_5) and mulch treatments (T_4). It is evident from the data given in table that the treatments where lantana mulch was applied resulted in significantly high value of saturated hydraulic conductivity as compared to rest of the treatments. Stale seed bed and raised stale seed bed in combination with hoeing resulted in higher value of saturated hydraulic conductivity as compared to hoeing alone although the treatments were statistically at par with each other. Treatment intercropping and intensive cropping accounted for higher value of saturated hydraulic conductivity as compared with crop rotation. The lowest value of saturated hydraulic conductivity was recorded in chemical check. In sub-surface soil, the lower values of saturated hydraulic conductivity were recorded in sub-surface soil as compared to surface soil and treatment wise trend was similar as observed in case of surface soil.

Stale seed bed and raised stale seed bed in combination with hoeing resulted in better growth of crop thus adding more crop residues and resulting in comparatively higher values of SHC as compared to hoeing. The higher saturated hydraulic conductivity values in lantana mulched treatment might be due to reduction in soil compaction due to addition of lantana mulch thus facilitating greater movement of water through soil pores as compared to non-mulched treatments. Due to increased biological activity, improved soil aggregation, and increased pore volume as well as effective pore connectivity, mulched treatments improved hydraulic conductivity. Comparatively higher values of saturated hydraulic conductivity in intercropping and intensive cropping as compared to crop rotation might be due to the addition of more crop residues and promoting macro-faunal activity thus increasing the soil porosity thereby increasing the saturated hydraulic conductivity. The significant lower values of SHC in chemical check might be due to non-addition of organic manure in chemical check as compared to all other treatments where organic manure was applied. The SHC values were found higher in the surface soil as compared to the sub-surface soils which might be due to more vigorous macro-faunal activity and higher pore continuity in the surface layer. The surface soil having relatively higher organic matter content was less compact as compared to the subsurface soils that resulted easy passage of water through it. Overall hydraulic conductivity showed decreasing trend with increase in soil depth (15-30 cm) in respective treatments (Pant and Ram 2018). Meshram *et al.* (2019) found that weed management treatments didn’t show any significant effect on hydraulic conductivity of soil.

Effect of weed management practices on soil mean weight diameter (MWD). Water-stable aggregates larger than 2 mm most crucial fractions in determining how fertilization procedures affect soil aggregation because they have a significant impact on the mean weight diameter, a comprehensive indicator for assessing soil structure.

The data on mean weight diameter (MWD) of soil as influenced by different weed management practices during the period under study have been presented in Table 2. A critical examination of data (Table 2) indicated that during first year the MWD ranged from 1.62 to 1.77 mm in surface soil to 1.51 to 1.65 mm in sub-surface soil and during second year, the MWD value ranged from 1.63 to 1.80 mm in surface soil to 1.52 to 1.68 mm in sub-surface soil.

It can be conjunctured from data in Table 2 that the season wise trend was similar in all the treatments and the highest value of MWD in surface soil was found in the treatment comprising RSSB + mulch (T_6) whereas, the lowest value was recorded in the treatment chemical check (T_{10}). The treatments where lantana mulch was applied resulted in significantly high value of MWD as compared to rest of the treatments. Stale seed bed and raised stale seed bed in combination with hoeing (T_2& T_3) resulted in higher value of MWD as compared to hoeing (T_1) although the treatments were statistically at par with each other. Treatment intercropping (T_7) accounted for higher value of MWD as compared with crop rotation (T_8) and intensive cropping (T_9). The lowest value of MWD was recorded in chemical check (T_{10}). The lower values of MWD were recorded in sub-surface soil as compared to surface soil and treatment wise trend was similar as observed in case of surface soil. The increase in soil aggregates due to the incorporation of organic matter might be due to the fact that FYM is capable of binding the soil particles together thus resulting in higher value of MWD in all treatments compared with chemical check. Soils that have a high content of organic matter have greater aggregate stability. There was a significant increase in MWD with incorporation of lantana mulch which may be attributed to increase in the percentage of macro aggregates in the soil because of production of more organic residues in the mulched plots. Additions of organic matter increase aggregate stability, primarily after decomposition begins and microorganisms have produced chemical breakdown products or mycelia have formed.

The fact that FYM enhanced MWD up to deeper layers suggests that, in addition to its direct effect as a binding agent, FYM may also have indirectly increased MWD by increasing root biomass, which raised the content of organic matter. Both Rasool *et al*. (2008); Tripathi *et al.* (2014) noted that the MWD was enhanced by the application of FYM. The stabilization of aggregates and therefore increased MWD with the application of FYM and inorganic fertilizers, which improves the physical condition of soil, may be caused by an increase in organic carbon content. In a chemical check, the balanced application of chemical fertilizers along with FYM encourages the growth of root biomass and root exudation, which increases the amount of organic matter in the soil and increases microbial activity, which in turn increases the production of polysaccharides and organic acids, improving the soil's mean weight diameter due to the gluing effect (Bhatt *et al*., 2017).

Table 1: Effect of weed management practices on soil bulk density, particle density and porosity.

Treatments	Bulk density (Mg m^{-3})				Particle density (Mg m^{-3})				Soil porosity (%)			
	2019-20		2020-21		2019-20		2020-21		2019-20		2020-21	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30cm	0-15 cm	15-30cm	0-15 cm	15-30cm	0-15 cm	15-30cm
T_1 : Hoeing	1.29	1.33	1.27	1.31	2.58	2.66	2.57	2.66	51.14	50.00	51.53	50.25
T_2 : SSB + hoeing	1.28	1.32	1.26	1.29	2.59	2.67	2.57	2.65	51.35	50.56	51.54	51.38
T_3 : RSSB + hoeing	1.28	1.31	1.26	1.29	2.56	2.67	2.55	2.64	51.55	50.94	51.75	51.4
T_4 : Mulch	1.26	1.30	1.23	1.28	2.54	2.63	2.52	2.61	52.27	51.49	53.05	51.88
T_5 : SSB + mulch	1.24	1.30	1.22	1.28	2.53	2.62	2.51	2.60	52.85	51.57	53.06	52.06
T_6 : RSSB + mulch	1.23	1.29	1.22	1.26	2.52	2.60	2.50	2.58	52.67	51.87	53.88	52.45
T_7 : Intercropping	1.26	1.31	1.24	1.29	2.57	2.62	2.55	2.60	50.97	50.00	51.37	50.38
T_8 : Crop rotation	1.26	1.32	1.24	1.30	2.56	2.61	2.54	2.58	50.78	49.43	51.18	49.61
T_9 : Intensive cropping	1.27	1.32	1.25	1.30	2.55	2.61	2.53	2.59	50.20	49.43	50.59	49.81
T_{10} : Chemical check	1.32	1.37	1.30	1.34	2.60	2.69	2.58	2.68	49.38	48.36	49.94	48.92
SE(m±)	0.02	0.02	0.02	0.02	0.05	0.04	0.05	0.04	1.2	0.8	0.6	0.7
LSD (P=0.05)	0.03	0.02	0.02	0.04	NS	NS	NS	NS	0.02	0.02	0.05	0.02

Table 2: Effect of weed management practices on soil water holding capacity (%), saturated hydraulic conductivity (cm hr^{-1}) and mean weight diameter (mm).

Treatments	Water holding capacity (%)				Saturated hydraulic conductivity (cm hr^{-1})				Mean weight diameter (mm)			
	2019-20		2020-21		2019-20		2020-21		2019-20		2020-21	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30cm	0-15 cm	15-30cm	0-15 cm	15-30cm	0-15 cm	15-30cm
T_1 : Hoeing	53.2	46.1	53.6	46.5	1.36	1.29	1.37	1.31	1.66	1.55	1.66	1.56
T_2 : SSB + hoeing	55.2	48.8	55.5	49.2	1.37	1.29	1.38	1.30	1.65	1.54	1.64	1.60
T_3 : RSSB + hoeing	55.6	48.2	56.0	48.6	1.38	1.31	1.38	1.32	1.65	1.54	1.67	1.58
T_4 : Mulch	57.2	51.3	57.6	51.6	1.55	1.45	1.56	1.47	1.74	1.62	1.75	1.65
T_5 : SSB + mulch	57.6	52.3	58.1	52.7	1.57	1.42	1.59	1.48	1.74	1.63	1.76	1.64
T_6 : RSSB + mulch	59.3	53.8	59.7	54.2	1.59	1.44	1.62	1.49	1.77	1.65	1.80	1.68
T_7 : Intercropping	55.2	50.5	55.6	51.0	1.48	1.38	1.50	1.39	1.71	1.65	1.73	1.68
T_8 : Crop rotation	56.4	52.3	57.1	52.7	1.43	1.33	1.45	1.34	1.65	1.55	1.67	1.58
T_9 : Intensive cropping	54.2	49.8	55.0	50.3	1.50	1.38	1.53	1.40	1.63	1.57	1.66	1.59
T_{10} : Chemical check	50.1	46.2	51.5	47.7	1.29	1.21	1.32	1.23	1.62	1.51	1.63	1.52
SE(m±)	1.0	1.0	1.0	1.0	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02
LSD (P=0.05)	1.9	1.4	1.8	1.1	0.05	0.07	0.04	0.05	0.06	0.04	0.05	0.05

CONCLUSIONS

The present study demonstrated that different organic weed management practices improved the soil physical properties over chemical check. The treatment RSSB + mulch resulted higher value of all soil physical properties in comparison to chemical check. Thus, it can be concluded that organic manures like FYM and vermicompost dominance over fertilizers and plays an important role to maintain soil physical health by improving soil physical properties.

FUTURE SCOPE

The impact of weed management practices on soil physical properties is very important for overall assessment of soil health. The soil's ability to support plant growth and supply nutrients is affected by soil's physical condition. As weeds drain significant amount of soil nutrients, and affect plant yield alongwith having significant impact on soil properties. Thus the study will help to assess the impact of weed management practices on soil's physical properties.

Acknowledgements. The authors sincerely acknowledge ICAR for technical and financial support in conducting the present study under 'All India Coordinated Research Project on Weed Management (AICRP-WM) and University Grants Commission, New Delhi for providing Junior Research Fellowship scholarship during the course of investigation.
Conflict of Interest. None.

REFERENCES

Abid, M., Batool, T., Siddique, G., Ali, S., Binyamin, R. and Shahid, M. J. (2020). Integrated nutrient management enhances soil quality and crop productivity in maize based cropping system. *Sustainability, 12,* 102-114.

Acharya, C. L., Kapur, O. C. and Dixit, S. P. (1998). Moisture conservation for rainfed wheat production with alternative mulches and conservation tillage in hills of north-west India. *Soil & Tillage Research, 46,* 153-163.

Bhatt, M. K., Raverkar, K. P., Chandra, R., Pareek, N., Singh, D. K. and Yaseen, M. (2017). Use of inorganic fertilizers and FYM for twenty-nine years in rice-wheat cropping system improves physical soil quality indices after rice. *International Journal of Current Microbiology and Applied Sciences, 6*(9), 3431-3438.

Bhushan, L. and Sharma, P. K. (2005). Long-term effects of lantana residue additions on water retention and transmission properties of a medium-textured soil under rice–wheat cropping in northwest India. *Soil Use and Management, 21*, 32–37.

Brar, B. S., Singh, K., Dheri, G. S. and Kumar, B. (2013). Carbon sequestration and soil carbon pools in a rice-wheat cropping system: Effect of long-term use of inorganic fertilizers and organic manure. *Soil & Tillage Research,128*, 30–36.

Brown, S. and Cotton, M. (2011). Changes in soil properties and carbon content following compost application: Results of on-farm sampling. *Compost Science & Utilization, 19*, 87–96.

Das, A., Kumar, M., Ramkrushna, G.I., Patel, D. P., Layek, J., Naropongla, Panwar, A. S. and Ngachan, S. V. (2016). Weed management in maize under rainfed organic farming system. *Indian Journal of Weed Science, 48*(2), 168–172.

Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedure for Agricultural Research. John Wiley and Sons, New York

Gupta, R. P. and Dhakshinamoorthy, C. (1980). Procedures for physical analysis of soils and collection of agrometeorological data, Division of Agricultural Physics, Indian Agricultural Research Institute, New Delhi.

Jeeva, M., Somasundaram, E., Arthanari, P. M., Thingalmaniyan, K. S. and Ganesan, K. (2020). Effect of weed management practices on tomato yield parameters, yield and soil microbial population. *International Journal of Current Microbiology and Applied Sciences, 9*(8), 946-952.

Karlen, D. L. and Cambardella, C. A. (1996). Conservation strategies for improving soil quality and organic matter storage. *Advances in Soil Science,* CRC Pres, Inc., Boca Raton. FL

Klute, A. (1965). Method of soil analysis part-I. pp. 210-220

Kumar, P., Pathak, R. K., Gaur, A. S., Shukla, D. P. and Yadav, G. (2020). Effect of weed management practices on physicochemical and biological properties of soils in wheat crop. *International Journal of Chemical Studies 8*(1), 270-276.

Kumar, R., Singh, R. S., Pandey, D. and Kumar, M.(2018). Weed management effect on weeds, crop, nutrients uptake and soil physico-chemical properties in blackgram. *Indian Journal of Weed Science, 50*(2), 180–181.

Kundu, R., Mondal, M., Garai, S., Banerjee, H., Ghosh, D., Majumder, A. and Poddar, R. (2020). Efficacy of herbicides on weed control, rhizospheric micro-organisms, soil properties and leaf qualities in tea plantation. *Indian Journal of Weed Science, 52*(2), 160–168.

Meshram, D. D., Deshmukh, M. R. and Gabhane, A. R. (2019). Consequences of various tillage management practices on soil physical properties and yield of soybean (*Glycine max*). *Journal of Pharmacognosy and Phytochemistry, 8*(3), 2797-2802.

Modak, D. P., Behera, B., Jena, S. N., Roul, P. K. and Behera, S. D. (2019). Nutrient uptake and yield of maize (*Zea mays* L.) in rice-maize system under tillage and weed management and impact on soil health.*International Journal of Chemical Studies,7*(3), 1786-1791.

Pant, P. K. and Ram, S. (2018). Long-term manuring and fertilization effects on soil physical properties after forty two cycles under rice-wheat system in North Indian Mollisols. *International Journal of Current Microbiology and Applied Sciences, 7*(7), 232-240.

Patel, V. K., Pathak, R. K., Kumar, A., Singh, A., Samiksha and Patel, A. (2020). Effect of tillage and weed management practices on soil physico-chemical characteristics and wheat economics.*International Journal of Current Microbiology and Applied Sciences, 9*(4), 2096-2102.

Piper, C. D. (1950). Soil and Plant Analysis. Inc. Sci. Pub. Inc, New York

Rao, V. S. (1993). Principles of weed sciences. Oxford and IBH publishing Co. New Delhi., p. 23-42.

Rasool, R., Kukal, S. S. and Hira, G. S. (2008).Soil organic carbon and physical properties as affected by long-term application of FYM and inorganic fertilizers in maize-wheat system. *Soil & Tillage Research, 10,* 31–36.

Sahoo, S., Roy, D. K., Kumar, M., Das, R. and Baldhaniya, M. J. (2021). Soil physicochemical properties as affected by organic weed management and conservation agriculture in rice- maize cropping system of IGP. *Biological Forum – An International Journal, 13*(1), 627-632.

Senthilkumar, D., Murali, Arthanari, P., Chinnusamy, C., Bharathi, C. and Yalabela, L. (2019). Stale seed bed techniques as successful weed management practice. *Journal of Pharmacognosy and Phytochemistry, SP2*, 120-123.

Sharma, P. K. and Acharya, C. L. (2000). Carry-over of residual soil moisture with mulching and conservation tillage practices for sowing of rainfed wheat (*Triticum aestivum* L.) in North-West India. *Soil & Tillage Research, 57,* 43-52.

Singh, R. A. (1980). Soil Physical Analysis.Kalyani Publishers, New Delhi

Subhan, A., Khan, Q. U., Mansoor, M. and Khan, M. J. (2017). Effect of organic and inorganic fertilizer on the water use efficiency and yield attributes of wheat under heavy textured soil. *Sarhad Journal of Agriculture, 33*(4), 582-590.

Tripathi, R., Nayaka, A. K., Bhattacharyya, P., Shukla, A. K., Shahid, M., Raja, R., Panda, B. B., Mohanty, S., Kumar, A. and Thilagama, V. K. (2014). Soil aggregation and distribution of carbon and nitrogen in different fractions after 41 years long-term fertilizer experiment in tropical rice–rice system. *Geoderma, 213,* 280-286.

Wagnet, R. J. and Hutson, J. L. (1997). Soil quality and its dependence on soil physical Processes. *Journal of Environment Quality, 26*, 41-48.

Yoder, R. E. (1936). A direct method of aggregate analysis and study of the physical nature of erosion losses. *Journal of American Society of Agronomy, 28*, 337-351.

How to cite this article: Neha Chauhan, Sanjay K. Sharma, S.S. Rana, Naveen Datt, Pardeep Kumar, Shabnam, Sakshi Vishvamitera, Deeksha Choudhary, Brij Vanita, Shivani Thakur, Gaytri Hetta, Sarwan Kumar and Nikhil Chauhan (2023). Assessing Effect of Weed management Practices on Physical Soil properties in An Acid Alfisol of Western Himalayas. *Biological Forum – An International Journal, 15*(3): 78-84.