Assessing the Productivity of Forage Based Cropping System under Different Farming Practices in the Western Himalayan Region

ABSTRACT

A field experiment was conducted at CSK Himachal Pradesh, Krishi Vishwavidyalaya Palampur, Department of Organic Agriculture and Natural Farming, College of Agriculture, during 2019-20 to study the effect of conventional, organic and natural farming practices on growth and yield of fodder oat. The experiment was laid out in split plot design with three replications with comprising of 5 farming practices (F_0: Absolute control, F_1: Organic farming package of practices, F_2: Natural farming package of practices (SPNF), F_3: 10 t FYM + Natural farming package of practices (SPNF), F_4: Recommended fertilizer dose and 3 cropping system (CS_1: Oat, CS_2: Oat + Fodder Sarson, CS_3: Oat + Berseem). The results concluded that, among the farming practices, higher number of shoots per meter square, dry matter accumulation, green fodder yield and dry fodder yield was recorded with recommended dose of fertilizer followed by 10 t FYM + natural farming package of practices (SPNF). In case of cropping systems, significantly higher number of shoots per square meter, dry matter accumulation, green and dry fodder yield was observed with oat + berseem cropping system as compared to oat alone.

Key words: Forage, Yield, Oat, Berseem, Farming practices

1. INTRODUCTION

Forages, the main stay of animal health are the backbone of livestock industry in India. The scarcity of green forages and grazing resources in the country has made the livestock to suffer continuously with malnutrition owing to its sub-optimum production as compared to developed nations. The success of livestock industry depends on feeding the animals with sufficient quantity of nutritious forage for their better maintenance, growth and production. Fodders are 5-14 times cheaper source of important feed ingredients like digestible crude protein and total digestible nutrients than concentrates (Agrawal *et al.* 2008). However, the supply of forage is inadequate both in terms of quantity and quality. Nearly 65-70% of the total cost of livestock farming is attributed to feeding. Thereby green fodder production in a good way can potentially meet the feed and fodder resources for sustainable livestock production.

The country at present faces a net deficit of 23.40 per cent in dry fodder, 11.24 per cent in green fodder and 28.90 per cent for concentrates (Anon., 2020). Shortage of 32 per cent green fodder in India was reported during 2020 which might increase upto 40 per cent by 2025.The demand will reach to 1012 million tonnes of green fodder and 631 million tonnes of dry forage by the year 2050. Himachal Pradesh covers 9,451 ha of cultivated area under fodder crops and 1508 thousand ha area under pastures and grasslands, which can only partially meet the requirements of large livestock population of 4.41 million (Anon., 2019). To fulfil the national deficit, green forage supply has to grow at 1.69 per cent annually above shrinkage of lands under forage crops (Anon., 2015). In the hilly state of Himachal Pradesh, the total annual availability of green and dry fodder is 31.45 and 52.98 lakh tonnes, respectively against the requirement of 62.06 and 198.38 lakh tonnes, respectively (Kumar 2014).

In the current scenario of fodder deficit, there are two alternatives to fill this gap between fodder requirement and availability i.e., either increasing the area under fodder production or improving the productivity per unit area per unit time. However, the ever-increasing demand for cash & grain crops limits the possibilities of area expansion. Therefore, crop intensification through mixed farming, intercropping of cereals with legumes, crop diversification, are some of the viable options to achieve the aforesaid objective.

Forages are heavy feeders hence greatly deplete soil of its nutrients particularly under fodder-fodder cropping system. It is therefore, important to manage the soil fertility in such a manner that could increase the forage productivity on a sustainable basis. The conventional crop production systems based on enhanced dependence on chemical fertilizers and pesticides are costly, besides causing environmental pollution and deteriorating human, animal and soil health. Therefore, it is imperative now to look for sustainable alternative farming methods which are socially acceptable, economically viable and ecologically sound.

In this context, organic farming, zero budget natural farming and their recommended chemical fertilizers could emerge as eco-friendly approaches to sustain the soil health and in turn the crop productivity. Therefore, increasing productivity in grass-based cropping system with a sustainable nutrient management approach is a 'win-win' strategy for sustainable food and fodder production. Comprehensive information on fodder-based cropping systems under various farming systems was meagre and hence, the present study was carried out on performance of forage-based cropping systems under conventional, organic and natural farming situations.

2. MATERIALS AND METHODS

A field experiment was conducted organic farm, Holta, Department of Organic Agriculture and Natural Farming, College of Agriculture, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur it is located at 32º6' N latitude and 76º3' E longitude. during 2019-20 and 2020-21. Soils of the experimental field was silty clay loam in texture, moderately acidic in reaction (pH 5.6), medium in organic carbon (6.7 g kg^{-1}), medium in available nitrogen (323.0 kg kg^{-1}), medium in available phosphorus (22.8.0 kg kg^{-1}) and high in available potassium (286.4 kg kg^{-1}). The experiment was layout in split plot design with main plots such as., F_0: Absolute control, F_1: Organic Farming Package of Practices, F_2: Natural Farming (SPNF), F_3: 10 t FYM+ Natural Farming (SPNF) and F_4: Recommended fertilizer dose. Sub plots such as., CS_1: Oat alone, CS_2: Oat + Fodder Sarson and CS_3: Oat + Berseem cropping system.

The data generated from field studies were subjected to statistical analysis. The technique of analysis of variance for split plot design (SPD) was used for the interpretation of results. Statistical analysis was done by standard procedure as described by Gomez and Gomez (1984). First cut was taken 68 days after sowing and 2nd cut was taken at 55 days after first cut during *Rabi* 2019-20.

3. RESULTS AND DISCUSSION

Growth attributes

Shoots per square meter

Among the different farming practices, recommended dose of fertilizer recorded the greatest number of shoots per square meter during both cuttings (104.55 first cutting) and (125.66 second cutting) during 2019-20 as compared to absolute control. While in the case of cropping system, oat + berseem recorded the highest number of shoots per square meter at the 1^{st} cut and 2^{nd} cut during the seasons of 2019-20 are presented in (Table 1). The higher number of shoots per square which might be due inorganic fertilizers are formulated to contain specific concentrations of essential nutrients (nitrogen, phosphorus, and potassium) that plants need for their growth and development (Kumar *et al.,* 2019). These nutrients are readily available in a soluble form, allowing plants to access them immediately (Westermann, 1993) and Thomas *et al.,* (2019).

Dry matter accumulation

Recommended dose of fertilizer recorded significantly higher dry matter accumulation during both cuttings (317.8 g/m^2 for first cutting) and (537.7 g/m^2 for second cutting) and also 10 t FYM + Natural Farming (SPNF) getting higher dry matter accumulation during rabi 2019-20 as compared to absolute control. While in the case of cropping system, oat + berseem recorded the higher dry matter accumulation (312.7 g/m^2 for first cutting) and (513.7 q/ha for second cutting) are presented in (Table 2). The dry matter accumulation which might be due inorganic fertilizers are formulated to contain specific concentrations of essential nutrients (nitrogen, phosphorus, and potassium) that plants need for their growth and development (Kumar *et al.,* 2019). These nutrients are readily available in a soluble form, allowing plants to access them immediately (Westermann, 1993) and Thomas *et al.,* (2019).

Green fodder and dry fodder yield

The data on green fodder and dry fodder yield were presented in Table 3. Among the different farming practices, recommended dose of fertilizers, recorded significantly higher total green fodder yield (363.5 q/ha) and total dry fodder yield (93.2 q/ha) followed by 10 t FYM + Natural Farming (SPNF) as compared to absolute control. The higher yield which might be due to supply of all major nutrient might have increased protoplasmic constituents and accelerated the process of cell division and elongation which has resulted in luxuriant vegetative growth there by higher green and dry fodder yields. The similar trends were followed by Patel *et al.,* (2010) and Dabhi *et al.,* (2017) in loamy sand soils of Anand (Gujarat) and Dubey *et al.,* (2013) in clay loam soils of Jabalpur (M.P.)

In case of cropping systems, significantly higher total green fodder yield (338.0 q/ha) and dry fodder yield (88.0 q/ha) observed in oat + berseem as compared to oat alone. The similar results were obtained by Thakar *et al.,* (2019) under sandy loam soils of Punjab (Ludhiana) found that application of 175 kg N/ha to gobhi sarson + oat fodder intercropping system resulted in significantly higher seed yield of gobhi sarson, green fodder yield of oat and gobhi sarson equivalent yield over other nitrogen levels with cropping system.

CONCLUSION

It was concluded that, among the farming practices, higher green fodder yield and dry fodder yield was recorded with recommended dose of fertilizer followed by 10 t FYM +

natural farming (SPNF). In case of cropping systems, higher green and dry fodder yield, was observed in oat + berseem cropping systems.

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Table 1. Effect of different farming practices and cropping systems on shoot number of oats (no/m^2)

Treatment		2019-20	
		Cut 1	Cut 2
Farming Practices			
F0:	Absolute control	72.33	88.66
F_1:	Organic Farming	91.33	109.33
F_2:	Natural Farming (SPNF)	82.66	97.66
F_3:	10 t FYM+ Natural Farming (SPNF)	98.44	117.00
F_4:	Recommended fertilizer dose	104.55	125.66
S.Em. ±.		1.32	1.67
C.D. at 5%		4.38	5.54
Forage based Cropping Systems			
CS_1:	Oat	71.0	85.38
CS_2:	Oat + Fodder Sarson	66.52	80.80
CS_3:	Oat + Berseem	68.19	84.13
S.Em. ±.		1.09	1.14
C.D. at 5%		3.25	3.38

Table 2. Effect of farming practices and cropping system on dry matter accumulation of rabi season (g/m^2)

Treatment		2019-20	
		Cut 1	Cut 2
Farming Practices			
F_0:	Absolute control	200.12	302.3
F_1:	Organic Farming	265.4	456.4
F_2:	Natural Farming (SPNF)	247.2	398.2
F_3:	10 t FYM+ Natural Farming (SPNF)	288.7	480.9
F_4:	Recommended fertilizer dose	317.8	537.7
S.Em. ±.		7.63	6.2
C.D. at 5%		22.3	18.8
Forage based Cropping Systems			
CS_1:	Oat	142.8	451.9
CS_2:	Oat + Fodder Sarson	291.6	482.1
CS_3:	Oat + Berseem	312.7	513.7
S.Em. ±.		6.50	2.89
C.D. at 5%		20.6	9.8

Table 3. Effect of different farming practices and cropping system on green fodder yield and dry fodder yield of oat based cropping systems.

Treatment		Green fodder Yield (q/ha)			Dry fodder yield (q/ha)		
		2019-20			2019-20		
		1st Cut	2nd Cut	Total yield	1st Cut	2nd Cut	Total yield
Farming Practices							
F_0:	Absolute control	50.50	111.90	209.3	13.20	29.40	55.0
F_1:	Organic Farming	61.20	183.10	306.7	17.00	48.80	81.2
F_2:	Natural Farming (SPNF)	52.60	157.20	264.7	14.20	40.90	69.5
F_3:	10 t FYM+ Natural Farming (SPNF)	66.50	195.00	321.3	17.80	50.10	83.3
F_4:	Recommended fertilizer dose	75.40	218.80	363.5	19.50	55.90	93.2
SEm±		1.00	3.89	4.63	0.41	0.74	1.11
C.D. at 5%		3.27	12.72	15.10	1.34	2.42	3.61
Cropping System							
CS_1:	Oat	59.30	173.40	232.8	15.20	43.40	64.3
CS_2:	Oat + Fodder Sarson	64.00	167.20	308.5	17.50	44.90	82.6
CS_3:	Oat + Berseem	60.50	178.90	338.0	16.30	46.70	88.0
SEm±		0.86	1.98	2.82	0.26	0.77	0.91
C.D. at 5%		2.54	5.84	8.35	0.78	2.30	2.68