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Sustainable Round the Year Green Fodder Production Modules under Subtropical Conditions of Jammu

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***Abstract*:** Round the year fodder production modules were established in an area of 2.5 ha at Instructional Livestock Farm Centre, R.S. Pura, SKUAST-Jammu. The area was allocated to different modules *viz*. Maize+Cowpea-Berseem+ Mustard module (area allotted 0.8 ha), Swankhi, Cowpea, Bajra-Berseem +Oats module (0.5ha), Sorghum-oats module (0.8 ha), perennial module viz. hybrid napier (0.35ha) and Para grass (0.05ha) along with boundary plantation of fodder trees and supplemental fodder module to feed fifty dairy animals during 2017-18 and 2018-19. Among seasonal fodder modules, maize+cowpea-berseem+mustard produced significantly highest system productivity including net returns, B:C ratio , monetary efficiency, LUE, production efficiency. Among perennial module, hybrid napier grass produced significantly highest system productivity, net returns, B:C ratio, monetary efficiency, production efficiency and energy productivity. However, supplemental module azolla provide feed every day. Thus integration of all sources of fodders ensured quality green fodder availability throughout the year besides improved soil fertility, sustaining monetary and production efficiency in long run.

Keywords: Fodder modules, Sustainability, Green fodder

Seasonal feed, fodder shortages and inefficient feed use by pastoralist and agro-pastoralist communities are the major challenges affecting livestock productivity in country, besides raising the cost of milk production to the tune of 60-70%. At present, India faces a deficit of 23.4%, 11.24% and 28.9% in the availability of dry fodder, green fodder and concentrates (ICAR-IGFRI 2021). The number of livestock population is growing rapidly @ 4.6 per cent (20th Livestock Census), but the grazing lands are diminishing gradually due to pressure on land for agricultural and non-agricultural uses (Ghosh et al 2019). In Jammu and Kashmir the devoted land to fodder is less than 4% (35.63 thousand hectare) of arable land with production of 64 lakh MT of green fodder and 35 lakh MT of dry fodder whereas against, the requirement of 139.13 and 58.53 lakh MT green and dry fodder. The assessment of feeds and fodders shows that a deficit of about 45% (including green and dry) in fodder and 85% in concentrate (feed) is being faced by J&K (ICAR-IGFRI 2021). There is no chance of horizontal expansion of land as the area under fodder cultivation is static and limited to about 4% of the cropping area for the last four decades. Besides this India faces a seasonal variation in the availability of fodder crops. Lush green fodder available in all months except during the months of May-June and November-December which are considered as lean period .Thus to meet the gap between demand and supply of the deficit and to lessened the variability in seasonal fodder the need of the time is to adopt the practices of fodder production that enhance productivity of fodder along with make the quality fodder accessible round the year. Keeping, above points in view the present investigation was undertaken with an objective to develop sustainable round the year green fodder production modules for feeding dairy animals.

MATERIAL AND METHODS

The experimental site where fodder block fully established was well drained clay loam in nature with neutral to slightly alkaline in soil reaction (7.15 to 7.9), oxidized soil organic carbon content varied from 0.6 to 0.64% with low in available N and medium in P & K respectively. The plan was executed and laid down by in an area of approximately 2.5 ha by making six blocks (A to F) of an area of 0.4 ha accordingly, each and every corner of land was kept under utilization of fodder as per the feasibility of an area. Different sources of fodder viz. seasonal fodders, perennial fodders grasses and trees and supplemental fodder azolla which is rich source of protein were tried. The data presented in the paper were collected for 2017-18 and 2018-19. In *Kharif* season fodders maize (*Zea mays*)+cowpea (*Vigna unguiculata L. Walp*.), swankhi *(Echinochloa frmentaceae)*, bajra (*Pennisetum glaucum),*cowpea (*Vigna unguiculata* L. *Walp*.), sorghum (*Sorghum bicolor L. Morlch*.) fodders were sown and in *rabi* season berseem (*Trifoloum alexandrinum)* +mustard (*Brasica compestris, var. Sarson*), berseem (*Trifoloum*

alexandrinum) +oats (*Avena sativa*), and oats (*Avena sativa*), were sown and in perennial fodders grasses like hybrid napier *(Pennisetum purpureum*), Paragrass (*Brachiaria mutica*) and in fodder tree spp. *Bauhinia variegate* and *Albizzia* spp were taken as boundary plantations 5m apart from each other. The supplemental fodder *Azolla pinnata* was grown from waste pits and drains . The seasonal fodder modules Maize+ cowpea- Berseem + mustard, Swankhi, Cowpea, Bajra-Berseem+Oats, Sorghum-oats were tested in blocks. The package and practice of subtropical Jammu region was followed. Staggered planting technique @ interval of 15 days was followed in annual cropping sequences. The supplementary information with respect to different fodder sequences with regard to dates of sowing and harvesting (Table 1). Initial composite surface soil samples (0-15 cm) were collected before land preparation of experimental field. Similarly, block wise surface soil samples also collected after harvesting of each plot, air dried, grounded and passed through 2 mm sieve were analyzed for soil reaction, organic carbon content and available N, P and K as per standard methods described by Jackson, (1973). System productivity (kg/ha/year) was calculated by adding produce of different seasons in a year. Land Use Efficiency (Tomar and Tiwari 1990). Production efficiency (Patil et al 1995). Energy budgeting (Lal et al 2003) were calculated. The data was analyzed by using software OPSTAT at probability level of 5%.

RESULTS AND DISCUSSION

Maize+Cowpea-Berseem+ Mustard modules (0.8ha): This module produced 1198q/0.80 ha/year of green fodder annually and supplied fodder in the July, September, December, January, February and April. Significantly highest system productivity of 149750 kg/ha/year, net returns Rs 114860.72, B:C ratio of 3.29, monetary efficiency of Rs 318.17/ha/day, production efficiency of 414.81 kg/ha/day

Table 1. Supplementary information w.r.t date of sowing and harvesting of different fodder modules for round the year fodder availability

Blocks	*Kharif*	*Rabi*	Area (ha)	Date of sowing		Date of harvesting					
				Kharif	*Rabi*	*Kharif*		*Rabi*			
						1st	2nd	1st	2nd	3rd	4th
A	Maize+Cowpea	Berseem+Mustard	0.4	1st May	1st Oct.	1st July-14th July	1st Sept.-6th Sep.	1st Dec.-7th Dec.	1st Jan.-17 Jan.	20th Feb.-28 Feb.	1st April-8th April
B	Maize +Cowpea	Berseem +Mustard	0.4	15th May	15th Oct.	15th July-31st July	3rd Oct.-10th Oct..	8th Dec.-18th Dec.	18 Jan.-31 Jan.	01 March-08 March	19th April-23rd April
C	Swankhi	Berseem +Oats	0.2	1st June	15th Oct.	1st Aug. -4th Aug.	7 Sept.-9 Sept..	19th Dec.-28Dec.	1Feb.-10 Feb.	09 March - 20 March	24th April-30th April
	Bajra	Berseem+oats	0.2	1st June	15th Oct.	8th Aug.-13th Aug.	1st Oct.-2nd Oct.				
	Cowpea	Berseem+Oats	0.1	1st June	15th Oct.	5th Aug-7th Aug..	-				
D	Sorghum	Oats	0.4	15th June	30th Oct.	14th Aug.-31 Aug.	11th Oct.-27Oct..	25th Dec.-31 Dec.	21stMarch-31st March	-	-
E	Sorghum	Oats	0.4	1st July	15thNov.	10th Sep. -30th Sept.	1st Nov.-20 Nov.	11 Feb.-26Feb.	9th April-18th April	-	-
F	Perennial fodder		0.35	July	-	1st May-31st May/1st June-28th June	-	28thOct-31st Oct./ 21-27Nov	-	-	-
	Hybrid Napier				-		-				
	Para grass		0.05	Aug		29th June-30th June	- -	28-30Nov.			
	Fodder trees		Boundary	July		-	-	31st Oct.			
	Supplemental fodder (Azolla)		Pits/ waste bodies	-		Daily (1 kg)round the year	-	-			

and energy productivity of 9.28kg/MJ (Table 2) was found in this system followed by sorghum + oats and swankhi, bajra, cowpea - berseem + oats respectively. It might be due to continuously diversified cropping of legumes along with cereals in this system for 361 days with highest LUE of 98.90%.The results are in collaboration of Luce et al (2020). This model also contributed and improved soil fertility by increasing organic carbon to the tune of 8%, available N 4-5%, available P 3-4 % and available K 2-3%, respectively (Table 3). Kumar and faruqui (2008) also found improved soil physico - chemical status of food-forage based system with respect to organic carbon (17%) and available N (12.7%) and P (27%) in 0–15 cm soil over initial level

Swankhi, Cowpea, Bajra-Berseem +Oats module (0.5 ha): This module produced 448q/0.50 ha/year of green fodder annually and supplied fodder in August, September, October, December, February, March and April. Among all annual fodder sequences, Swankhi, Cowpea, Bajra-Berseem +Oats model cropping sequence recorded significantly lowest system productivity of 89700kg/ha/year ,B:C ratio of 1.83 ,energy productivity of 6.53kg/MJ ,monetary efficiency of Rs 182.34 ha/day and production efficiency of 282.07 kg/ha/day, respectively (Table 2). This lowest productivity is due to use of sole crops of swankhi, bajra and cowpea in their respective blocks during *Kharif* season which drastically reduced the *Kharif* yield and thus effect total system productivity. Similar results were reported by Wang et al (2014). With respect to soil fertility soil organic carbon content, available N, available P and available K was improved to 11, 3, 1.5 and 2.5% over their initial level due to inclusion of legumes in the modules. Kakraliya et al (2018) also found the similar results

Sorghum-oats module (0.8ha): This module produced 993.07 q/0.80 ha/year of green fodder annually and provided fodder during August, September, October, November, December, February, March and April. This module produced system productivity of 124134 kg/ha/year, B:C ratio of 3.11, highest energy productivity of 10.80,monetary efficiency of Rs 303.09/ha/day and production efficiency of 400 kg/ha/day. The findings were in agreement of that of Gracia et al (2016). Contribution tosoil fertility was also found in this system, soil organic carbon was build up to 5-6%, available N up to 2-5%, available P up to 4-5% and available K up to 2-7%, respectively (Table 3).

Perennial fodder modules (0.4 ha): This module produced 581.85q/0.40 ha/year of green fodder annually during May, June, October, November. Among perennial grasses hybrid napier recorded significantly highest system productivity (154285 kg/ha), net returns (Rs 120425.71), B:C ratio (3.55), monetary efficiency (Rs 329.93/ha/day) and production efficiency (422 kg/ha/day) (Table 2). The results were in agreement with Bhakhar and Ram (2019). Among fodder trees Bahuinia varigata out yielded Albizzia spp in system productivity and also provide fodder during the time of scarcity. Under perennial sources organic carbon content increased up to 11%, Available N 6%, available P 5 %, and available K 10% respectively. Sarkar (2018) observed that growing perennial fodder crops build up soil fertility.

Supplemental fodder modules: Azolla was grown as supplemental fodder in the waste pits and contributed 365 kg

Table 2. Evaluation of different fodder modules on basis of productivity, economics and efficiency

Cropping sequence models	System productivity (kg/ha/year)	System cost of cultivation (Rs)	Total net returns (Rs)	B:Cratio	Energy productivity (kg/MJ)	Monetary efficiency (Rs/ha/day)	LUE (%)	Production Efficiency (kg/ha/day)
Maize+ cowpea- Berseem + mustard	149750	34889.28	114860.72	3.29	9.28	318.17	98.90	414.81
Swankhi, Cowpea, Bajra-Berseem+Oats	89700	31716.40	57983.60	1.83	6.53	182.34	87.12	282.07
Sorghum-oats	124134	30176.00	93,958	3.11	10.80	303.09	84.93	400.00
Perennial fodder	-	-	-	-				
Hybrid Napier	154285	33,860	120425.71	3.55	10.57	329.93	100.00	422
Para grass	74000	23,709	50,291	2.12	10.79	137.78	100.00	203
C.D	13519	-	-	-	-	-	-	-
S.E(m)+	4486	-	-	-	-	-	-	-
Fodder trees (20nos,)		-	120	-	0.76	0.33	100	0.33
Bauhinia variegata (10 No.)	80	-	-	-	-	-	-	-
Albizzia (10No.)	40	-	-	-	-	-	-	-
Supplemental fodder (Waste pits/drains)	365	-	365	-	5.80	1.00	100	1.00

Table 3. Changes in soil fertility as affected by round the year green fodder production

Blocks	*Kharif*	*Rabi*	Area (ha)	Soil pH		Organic carbon (%)		Average N (kg/ha)		Average P (kg/ha)		Average K (kg/ha)	
				Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
A	Maize+Cowpea	Berseem+Mustard	0.4	7.9	7.85	0-60	0.64	240	252	17.48	17.95	120	124
B	Maize +Cowpea	Berseem +Mustard	0.4	8.2	8.10	0.60	0.65	232	243	16.71	17.10	117	120
C	Swankhi	Berseem +Oats	0.2	7.9	7.80	0.62	0.69	239	247	17.82	18.08	125	128
	Bajra	Berseem+Oats	0.2										
	Cowpea	Berseem+Oats	0.1										
D	Sorghum	Oats	0.4	7.56	7.70	0.60	0.63	218	230	17.25	18.00	120	129
E	Sorghum	Oats	0.4	7.15	8.00	0.64	0.68	235	239	17.19	18.15	120	122
F	Hybrid Napier		0.35	7.80	8.00	0.62	0.69	241	256	18.18	19.10	110	121
	Para grass		0.05										
	Fodder trees		Boundary										
	Supplemental fodder (Azolla)		Pits/waste bodies										

in system productivity along with 5.80 in energy productivity and 1kg/ha/day in production efficiency. Kour et al (2020) found azolla supplementation in feeding regimen of crossbred cows is beneficial which is evident by increased milk yield, milk fat yield and improved benefit cost ratio.

CONCLUSION

The green fodder production models developed under Northwestern Himalayas which included diverse sources of fodders viz. annual, perennial grasses, fodder trees, supplemental fodder along with management techniques of staggered planting ensured the round year availability of quality fodder which may varies with the number of animals, and land holdings. Further modules with higher system productivity should be encouraged for sustained yield throughout year.

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