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Forage production potential of oat (*Medicago sativa* L.) – Lucerne (*Avena sativa*) intercropping under sole and intercropping systems

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Abstract
A field experiment was conducted during *rabi* season of 2016-2017 at Navsari, Gujarat to study the forage production potential of oat (*Medicago sativa* L.) – lucerne (*Avena sativa*) intercropping under sole and intercropping systems. Intercropping system had significant effect on green fodder yield, dry fodder yield, land equivalent ratio, gross returns, net returns and benefit: cost ratio. The results of the experiment showed significant increase in green fodder yield of oat and lucerne, dry fodder yield of oat under different row ratios. However, oat + lucerne in the ratio of 2:1 recorded significantly highest green fodder yield (991.14 q/ha) of oat and lucerne as well as significantly higher dry fodder yield (114.12 q/ha) of oat. The maximum land equivalent ratio (1.44) gross returns (1,98,225/ha), net returns (1,66,341/ha) and benefit:cost ratio (6.22).

Keywords: Forage production potential, (*Medicago sativa* L.), Lucerne (*Avena sativa*), intercropping under sole, intercropping systems

Introduction
Livestock rearing is very important part of our rural economy not only for animal products, but also for draft power.Availability of green forage to animals is the key to success of dairy enterprises and it is difficult to maintain the health and milk Production of the livestock without supply of green fodder.At present, the country faces net deficit of 61.1% green fodder, 21.9% dry fodder. This situation indicates that green forage supply has to grow at 3.2% to meet the deficit (Kumar and Faruqui, 2010) [5]. As a result of deficit in fodder availability livestock suffers continuously with malnutrition for the year round in general, resulting in their production capacity at sub-optimum level.Intercropping of botanically diverse forage species like cereals and legumes appears to be one of the feasible approaches for increasing the fodder yield, utilization of land more efficiently improving fodder quality and providing stability to production (Tripathi, 1989) [14].

Materials and Methods
A field experiment was conducted during *rabi* season of 2016-2017 at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari. The soil of experimental the field was clayey in texture, having pH 7.8, low in organic carbon content (0.44%), low in available nitrogen (206.50 kg/ha), medium in available phosphorus (38.20 kg/ha) and fairly rich in available potassium (323.18 kg/ha).
The experiment was laid out in Randomized Block Design and replicated four times, six treatments comprising of T_1 sole oat, T_2 sole lucerne, four row ratios of T_3 oat + lucerne (1:1), T_4 oat + lucerne (1:2), T_5 oat + lucerne (2:1) and T_6 oat + lucerne (2:2) were evaluated in present study.)The oat and lucerne cultivars Kent and Anand lucerne-2 were used as test crop respectively for oat and lucerne were sown, 30 cm spacing in row proportion as per treatments in third week and fourth week of November. The seed rate under sole and intercropping was maintained at 100 and 25 kg/ha, respectively for oat and lucerne. Recommended dose of fertilizer was applied to both the component crops as basal application. The crop was raised under irrigated conditions with recommended agronomic practices. Total two cuts were taken with the first cut at 54 days after sowing and second cut at 52 days after sowing.The growth parameters, viz. initial plant population/metre row length, plant height and dry matter accumulation (g/plant) were recorded at each cutting. Green fodder yield recorded immediately after harvest of crops, whereas dry fodder yield of oat was recorded after sun drying at each cut. The plant samples were collected from each plot for dry matter accumulation, crude fibre and estimation of nitrogen for crude-protein content following

standard procedure. The economics was calculated on the basis of prevailing market prices of different inputs and output.

Results and Discussion

Green and dry fodder yields

Green fodder and dry fodder yields were significantly affected by different intercropping treatments (Table 1). The total green fodder (991.14 q/ha) was highest under oat + lucerne in 2:1 row ratio and significantly superior to the other intercropping systems and sole stand of oat and lucerne. The increase in total green fodder yield of oat-lucerne intercropping system in 2:1 row ratio was 42.37 and 45.95% oversole oat and sole lucerne, respectively. The data also indicated that all systems of oat + lucerne showed yield advantage over sole oat and sole lucerne. However, total forage yield was greater because of contribution of oat. The increase in total green fodder and dry matter yields in the intercropping systems might be owing to better utilization of space and light interception coupled with nutrient contribution of leguminous fodder to cereal. The results are in agreement to those to Kumar (2005) [6], Sharma *et al* (2009) [10] and Deore *et al.* (2013) [2].

The data on total dry fodder yield clearly indicated that various treatments of sole and intercropping systems significantly differed among each other. The maximum total dry fodder yield (114.12 q/ha) was obtained under sole oatbut it was found statistically at par with T_5 oat + lucerne 2:1 row ratio (101.08 q/ha). Oat in 1:1, 1:2 and 2:2 row ratio reduced the dry fodder yield over sole cropping of oat. However, total dry fodder yield of sole oat is closely followed by oat + lucerne in 2:1 row ratio. These results confirmed findings of Patel *et al.* (2008) [8], Surve *et al.*, (2012) [13] and Chaplot (2014) [1].

Land equivalent ratio (LER)

Land-equivalent ratio (LER) calculated from combined intercrop yield was higher in all intercropping system, than either of the sole crops, i.e. oat and lucerne. This clearly indicated greater biological efficiency of the intercropping treatments (Table 2). The significantly highest mean LER (1.44) was recorded in intercropping of oat and lucerne planted in the row ratio of 2:1, followed by oat + lucerne 1:2row ratio (LER=1.31). It showed that to produce combined mixture yield by growing sole stand would require 44% more land. Land-equivalent ratio for intercropping where it was more than 1, indicating suitability of the practice in quantitative term. The present findings are in accordance with those of Patel and Rajgopal (2003) [9], Kumar *et al.* (2005) [6], and Surve *et al.* (2012) [13].

Table 1: Green fodder yield of oat and lucerne at first and second cut as influenced by different row ratio under intercropping system

Treatment	Green fodder yield (q/ha)				
	Oat		Lucerne		Total
	First cut	Second cut	First cut	Second cut	
T_1 : Sole Oat	430.75	265.38	-	-	696.13
T_2 : Sole Lucerne	-	-	372.25	306.83	679.08
T_3 : Oat + Lucerne (1:1)	268.13	169.06	231.19	188.44	856.81
T_4 : Oat + Lucerne (1:2)	218.44	132.63	298.69	248.19	897.95
T_5 : Oat + Lucerne (2:1)	381.94	234.88	202.88	171.44	991.14
T_6 : Oat + Lucerne (2:2)	255.94	178.13	225.68	194.13	853.86
CD at 5%	49.82	30.86	30.93	30.22	51.48

Table 2: Dry fodder yield of oat as influenced by different row ratio under intercropping system

Treatment	Dry fodder yield (q/ha)		
	First cut	Second cut	Total
T_1 : Sole Oat	70.10	44.03	114.13
T_2 : Sole Lucerne	-	-	-
T_3 : Oat + Lucerne (1:1)	42.55	27.73	70.28
T_4 : Oat + Lucerne (1:2)	33.83	21.75	55.58
T_5 : Oat + Lucerne (2:1)	62.58	38.50	101.08
T_6 : Oat + Lucerne (2:2)	39.70	29.68	69.38
S.Em±	2.47	1.94	2.67
C.D at 5%	7.64	5.98	8.23

Table 3: Economics of oat and lucerne as influenced by different row ratio under intercropping system

Treatment	Cost of production (≠/ha)	Gross realization (≠/ha)	Net realization (≠/ha)	BCR	LER
T_1 : Sole Oat	29681	139226	109545	3.69	1
T_2 : Sole Lucerne	34320	135816	101496	2.96	1
T_3 : Oat + Lucerne (1:1)	32000	171362	139362	4.35	1.25
T_4 : Oat + Lucerne (1:2)	32696	179590	146894	4.49	1.31
T_5 : Oat + Lucerne (2:1)	31073	198228	167155	5.38	1.44
T_6 : Oat + Lucerne (2:2)	32000	170772	138772	4.34	1.24

Economics

All the intercropping systems recorded higher gross and net returns as well as monetary advantages than sole cropping of component crops (Table 2) indicating thereby that intercropping being a productive and remunerative system of cultivation. The intercropping of oat and lucerne under different row ratio increase gross and net returns. The highest gross and net returns (1,98,225 and 1,66,341/ha)

were recorded in oat and lucerne 2:1 row ratio followed by oat +lucerne in 1:2 row ratio (1,79,590 and 1,46,082/ha). This was due to higher productivity of the system than other intercropping and sole cropping treatments.Similar results has been also reported by Sharma *et al.* (2008) [11], Singh *et al.* (2009) [12], Kheroar and Patra (2014) [4], Mandal *et al.* (2014) [7], Dhonde *et al.* (2016) [3].

Thus, it could be inferred from the above study that oat proved to be more compatible intercrop with lucerne in 1:2 row proportion planted in uniform rows with the highest productivity, land use efficiency and monetary return.

On the basis of the results obtained in present investigation, it can be concluded that by growing fodder oat and lucerne in 2:1 row ratio increased 44% green fodder yield over sole cropping provide higher economic benefit.

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