

Effect of cropping systems and sowing methods on the performance of winter-season fodder crops under rainfed conditions

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ABSTRACT

A field experiment conducted in split-plot design during the winter seasons (*rabi*) of 1986-87 and 1987-1988 showed higher herbage yield of oat (*Avena sativa* L.) than barley (*Hordeum vulgare* L. *sensu lato*) and oat + barley. Growing of fodder crops in combination with pea (*Pisum sativum* L. *sensu lato*) and sarson (*Brassica* sp.) was superior for forage production, yielding 16.4 and 3.9 q more green-foreage per hectare than pure stand of the crops respectively. Line sowing of the crops maintained its superiority to broadcast sowing. The highest profit of Rs 8,565, 7,819 and 8,079/ha was recorded in oat, crops grown with pea and line sowing of the crops respectively.

Though natural grasslands are the major source of fodder in Himachal Pradesh during the rainy season, an acute shortage of fodder is experienced during lean months, viz. November to June. With the pressing demand on land for food production the area under pastures is gradually decreasing, leaving suitable crops and their mixtures as the only alternative to boost fodder production. Oat (*Avena sativa* L.) and barley (*Hordeum vulgare* L. *sensu lato*) are the important winter cereal fodder crops, generally grown with broadcast sowing by the farmers under rainfed conditions. Hence keeping in view the above facts the present study was undertaken to study the effect of cropping systems and sowing methods on the production potential of winter-season (*rabi*) fodder crops under rainfed conditions of

Himachal Pradesh.

MATERIALS AND METHODS

The field experiment were conducted during the winter seasons of 1986-87 and 1987-88 at Palampur. The soil was silty clay loam in texture, medium in organic carbon (0.89%), available nitrogen (516 kg N/ha), available phosphorus (9.5 kg P/ha) and high in available potash (316 kg K/ha), with pH 5.5. The experiment was laid out in split-plot design with 3 replications. The main plots were assigned to all the combinations of 3 fodder crops (oat, barley and oat + barley) and 3 cropping systems, viz. fodder crops [pure, fodder crops + pea broadcast, fodder crops + sarson (*Brassica* sp.) broadcast], and 2 sowing methods, viz. line sowing and broadcast sowing, were assigned to subplots.

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In line sowing oat ('HPO 7B8') and barley ('Dolma') were sown in lines spaced 20 cm apart using seed @ 125 kg/ha. Companion crops—pea ('Local Sain') and sarson ('FOS 902')—were broadcast in main-crop sown plots using seed rates of 40 kg and 8 kg/ha respectively. In broadcast treatments seed of the crops was broadcast in the plots and covered with planker. Recommended doses of fertilizers were applied through urea and single superphosphate and no additional fertilizers were applied to the companion crops. Crops were sown on 25 October and 10 November in the first and second year respectively. Rainfall (during October–May, 15.0–235.8 and 1.3–200.8 mm) received was 709.5 and 436.2 mm and moisture content at the time of sowing in 0–15 cm soil depth was 22.12 and 20.11% during the first and second seasons respectively. The field capacity, permanent wilting point and available soil moisture were 27.70–28.30%, 16.30–16.80% and 22.12–24.19 cm in 0–45 cm soil depth. In 0–45 cm soil depth the moisture content was 22.19–24.19 and 20.11–25.31% during 1986–87 and 1987–88 respectively. Three cuts in the first year and 2 cuts in second year were taken.

RESULTS AND DISCUSSION

Effect of fodder crops

The oat crop recorded higher fresh- and dry-forage yields than barley and oat + barley in both the years under rainfed conditions. On the basis of pooled data, the oat crop gave significantly additional green-forage yield (47.9 q) and dry-forage yield (11.1 q) over barley crop. Pure crop of oat also gave additional green-forage yield of 48.8 q/ha over oat + barley mixture. This may be due to fact that yield is the additive and complementary effect of growth and yield-attributing parameters. Yield

attributes, viz. plant height and shoots/m², were more in oat, resulting in high yield. Though total shoots/m² of oat and barley did not show much difference, oat produced plants with taller height. Lower yield of oat + barley than that of oat may be because of less number of total shoots/m², as the individual crops of oat and barley (related species) have more competition among themselves for growth factors (Grafs, 1981).

Effect of cropping systems

Forage yield was affected significantly by different cropping systems. Mixed stand of the crops resulted in significantly higher herbage yield over pure stand of the crops. Plant height of fodder crops due to introduction of pea or mustard remained unaffected, whereas total shoots per unit area in mixed stand (main + companion) were considerably more resulting in higher production. Fodder crops in combination with pea gave significantly more green forage yield (12.5 q) and dry-forage (3.5 q) over the mixture of fodder crops with sarson. The failure of sarson to prove a better associate than pea is due to its contribution only in the first cut, because at the time of first cut the crop was in flowering stage and has completed its vegetative phase, hence failed to regenerate (Dhar, 1976). The contribution of pea in the second cut resulted in more plant height than mustard.

Effect of sowing methods

Significantly higher herbage yields during both the years was owing to line sowing. Line sowing of the crops gave 35.0 q and 9.2 q more green and dry-forage yields respectively over broadcast sowing in pooled data. Possible reasons for increased green- and dry-forage yield under line sowing may be that line sowing ensured better and

Table 1. Effect of cropping systems and sowing methods on mean plant height, number of shoots, green- and dry-forage yields and net return of winter-season fodder crops

Treatment	Plant height (cm)				No. of shoots/m ²				Green-forage yield (q/ha)	Dry forage yield (q/ha)	Net return (Rs/ha)
	Oat	Barley	Pea	Sarson	oat	Barley	Pea	Sarson			
<i>Fodder crop</i>											
Oat	192.9		77.3	59.4	1,650		124	125	271.3	62.3	8,565
Barley		156.7	79.1	59.6		1,632	125	127	223.4	51.2	6,583
Oat + barley	192.4	156.8	78.1	58.3	824	778	123	122	222.5	46.9	6,555
CD (P = 0.05)	NS	NS	NS	NS	11	9	NS	NS	9.2	3.1	
<i>Cropping systems</i>											
Pure fodder crops	190.0	156.4			1,166	1,152			235.1	54.9	6,905
Fodder crop + pea broadcast	190.9	156.0			1,162	1,146			251.5	57.9	7,819
Fodder crop + mustard broadcast	188.8	155.4			1,156	1,127			239.0	53.4	7,426
CD (P = 0.05)	NS	NS			NS	8			9.2	3.1	
<i>Sowing method</i>											
Line sowing	195.1	157.4	79.0	61.3	1,367	1,325	137	127	259.4	60.0	8,079
Broadcast sowing	192.8	155.0	75.9	59.0	1,072	1,074	133	125	224.1	50.8	6,619
CD (P = 0.05)	NS	NS	NS	NS	8	9	NS	NS	8.1	2.3	

uniform stand of the crop. This is because of uniform distribution and proper depth of the seed, better germination, proper development of root-system, leading to efficient nutrient absorption and stress tolerance and hence more number of shoots per unit area. The results confirm the findings of Barnett and Comean (1980).

Economics

The highest mean net profit of Rs 8,568/ha was recorded in oat crop. Among cropping systems, fodder crops in association with pea showed its superiority for economic return (Rs 7,819) over pure stand of the crops and crops sown in association with sarson. Sowing of crops through broadcasting gave low net return (Rs 6,619) than the crops sown in lines (Rs

8,079) in our experiment.

It was concluded that higher green- and dry-forage yields and economic returns may be obtained by sowing oat crop in lines in combination with pea under rainfed conditions of Himachal Pradesh.

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