



## Intensification of cropping through introduction of second crop after peas in Lahaul valley of Himachal Pradesh

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### Abstract

A field experiment consisted of seven pea based cropping sequences *viz.* Pea-mustard 'NDRE 4', Pea-mustard 'JD 6', Pea-toria 'Bhawani', Pea-local sarson 'Yunger', Pea-French bean 'Contender', Pea-buckwheat 'Local' and Pea-buckwheat 'USDA' was conducted at Kukumseri (Lahaul and Spiti) during 2010 and 2011 to find out the most remunerative second crop after main pea crop for dry temperate conditions of western Himalayas. The local sarson 'Yunger' took the least days (58 days) for maturity closely followed by French bean. Buckwheat USDA took highest number of days (92) to mature. Among new introduced mustard varieties 'NDRE 4' took 81 days. The highest pea equivalent yield (6377 kg/ha) with net return of INR 86714/ha and B: C ratio of 1.82 was obtained from pea-Frenchbean 'Contender' sequence followed by pea-mustard 'NDRE 4' (5561 kg/ha) with net return of INR 81478/ha and B: C ratio of 1.86. The increase in yield and net return with the best sequence (pea – Frenchbean 'Contender) over the most prevalent pea- local sarson 'Yunger' sequence was 24.9 and 23.8%, respectively.

**Key words:** Pea, cropping sequence, economics

Several studies were undertaken on crop diversification and intensification in low and mid hills of Himachal Pradesh (Sharma *et al.* 2007, 2008, 2009; Rana *et al.* 2010, 2011). However, in the high hills zone of Himachal Pradesh where cropping season is limited, studies on intensification of cropping are scanty (Rana *et al.* 2003; 2005; 2006; Sharma *et al.* 2015). The cropping season in this dry temperate area is very short starting from Mid March or First week of April till October at the most. Lahaul & Spiti district of Himachal Pradesh falls under high hill dry temperate zone in north western Himalayas. In most part of Lahaul valley only one crop mainly pea is taken. But with increase in temperature in last few years in later part of year *i.e.* August to October, a short duration second crop was also cultivated by the farmers. The pea crop vacate the field in early to mid July and the time left for the second crop before onset of winter is 80-90 days. The second crop

of buckwheat or local sarson 'Yunger' cultivated after pea are low yielders. Thus, there is scope for introduction of remunerative crops with maturity duration of 80-90 days. Keeping these facts in view, introduction of new genotypes of rapeseed – mustard and other crops which can best fit in the short cropping duration of this valley and help in increasing the productivity and profitability per unit area and time was required to be undertaken.

### Materials and methods

The experiment was conducted at Kukumseri (32°46'15" N latitude; 76°41'23" E longitude and 2734 m altitude) during 2010 and 2011. The climate of the site was extremely cold and heavy snowfall occurs during winter. The temperature remains several degrees below zero. Single cropping season was prevailing in the region which starts from April to September or early October when the mean minimum and maximum temperature ranges between 12°C to 24°C.

There was negligible rainfall followed by high light intensity and low humidity. Average annual rainfall of the region was 250 mm. The soil of the site was sandy loam with organic carbon of 0.3% and pH 6.9. Soils were shallow in depth and loose in texture resulting in poor water holding capacity. The available nitrogen, phosphorus and potassium were medium, high and low, respectively. The experiment consisted of seven cropping sequences *viz.*, pea-mustard 'NDRE 4', pea-mustard 'JD 6', pea-toria 'Bhawani', pea-local brown sarson 'Yunger', pea-French bean 'Contender', pea-buckwheat 'local' and pea-buckwheat 'USDA' was laid out in randomized block design with three replications. The pea crop was planted on 28 March and 24 March during first and second year, respectively. The pea crop was harvested on 14<sup>th</sup> and 11<sup>th</sup> July in respective years. The second crop in a sequence was sown immediately after the harvest within two days. All the crops were sown with recommended package of practices under irrigated condition. Snow-melt water, the only source of irrigation was used to irrigate crops through sprinklers, rain gun or *Kuhl*. The rest of the management practices were in accordance with the recommended package of practices for the individual crops. The crops were harvested from net plot. For comparison between crop sequences, the economic yields of crops were converted into pea equivalent on price basis. Land utilization efficiency was worked out by summation of duration of each crop under individual crop sequence divided by 365. Production efficiency (kg/ha/day) was obtained by dividing total production in terms of pea equivalent in a sequence by the total duration of year (365), while profitability (INR/ha/day) was obtained by dividing net monetary return by 365. Economics of cropping sequences was computed based on prevalent market prices.

## Results and Discussion

### Crop phenology and yield

The local sarson 'Yanger' was the earliest to mature in 58 days followed by French bean and local variety of buckwheat, each in 66 days (Table 1). Among the improved varieties of rapeseed mustard, toria 'Bhawani' matured in 67 days followed by mustard variety 'NDRE 4' in 81 days. The only second crop to mature after 90 days was buckwheat variety 'USDA'. The mustard cultivar 'JD 6' was also late maturing (86 days). Cultivated land utilization index owing to double cropping increased from 29.7% under the single cropping of peas to 45.6-54.9%. This is clearly indicated that even after the best utilization of the land under cropping, the cropping season can hardly be

extended beyond 55% time of the year. For the next five to six winter season months when the area faces extreme cold with occasional snowfall, some suitable strategy needs to be worked out for the region. In these areas the cultivated duration can best be extended by promoting greenhouse/polyhouse technology. For this policy and research interventions must need due attention. Similar efforts as in the present study, few efforts were also made by earlier workers to extend the cropping season in these areas (Rana *et al.* 2003; 2005; 2006; Sharma *et al.* 2015).

The data on yield of different crops are summarized in Table 2. The highest pea equivalent yield (6377 kg/ha) was obtained from Pea-French bean 'Contender' sequence followed by Pea-mustard 'NDRE 4' (5561 kg/ha) and Pea-toria 'Bhawani' (5239 kg/ha). The increase in pea equivalent yield over the most prevalent pea – local sarson 'Yunger' sequence with these three better sequences was 24.9, 8.9 and 2.6%, respectively. The pea-buckwheat sequences were the lower yielders. The matter of caution here is that while sowing second crop in sequence, it must gets at least 80 days maturity duration before temperature will go drastically down by mid October. Although pea-French bean sequence is the highest yielder but its bulk transfer in case of early snowfall will be a concern and at same time it will compete with the produce from the lower belt. Hence, the second best option after peas could be toria variety 'Bhawani' or mustard variety 'NDRE 4' for the marginal farmers of valley. Owing to higher pea equivalent yield, productivity efficiency was highest under pea – French bean 'Contender' (17.5 kg/ha/day) followed by pea – mustard 'NDRE 4' (15.2 kg/ha/day) (Table 3).

### Economics

The highest net returns were obtained from Pea-Frenchbean 'Contender' cropping system (INR 86,714) followed by pea-mustard 'NDRE 4' (INR 81,478) (Table 3). Similarly profitability was highest under pea – French bean 'Contender' cropping system (INR 238/ha/day) followed by pea-mustard 'NDRE 4'. However, the B:C ratio was highest from pea-mustard 'NDRE 4' (1.86). This was followed by pea – French bean 'Contender'. The net returns and the B:C ratio were lowest when buckwheat was taken as second crop.

Conclusively the traditional pea-local sarson 'Yunger' sequence can be replaced with most remunerative pea – French bean 'Contender' sequence. Alternatively, marginal farmers should adopt either pea - mustard 'NDRE 4' or Pea - toria 'Bhawani' if market is not available for French bean. These sequences can meet the oil requirement for the six months winter land locked valley.

**Table 1.** Days to maturity and cultivated land utilization index under different cropping sequences

Cropping sequence	Days to maturity						Land utilization index (%)		
	First crop			Second crop			2009	2010	Mean
	2009	2010	Mean	2009	2010	Mean			
Pea-mustard 'NDRE 4'	108	109	108.5	80	82	81	51.5	52.3	51.9
Pea-mustard 'JD 6'	108	109	108.5	89	83	86	54.0	52.6	53.3
Pea-toria 'Bhawani'	108	109	108.5	69	65	67	48.5	47.7	48.1
Pea- local sarson 'Yungar'	108	109	108.5	59	57	58	45.8	45.5	45.6
Pea-Frenchbean 'Contender'	108	109	108.5	68	64	66	48.2	47.4	47.8
Pea-buckwheat 'Local'	108	109	108.5	66	66	66	47.7	47.9	47.8
Pea-buckwheat 'USDA'	108	109	108.5	94	90	92	55.3	54.5	54.9
LSD (P=0.05)	-	-	-	2.7	2.1	3.4			

**Table 2.** Production of pea based cropping sequences under dry temperate conditions in north western Himalayas

Cropping sequence	Green peas yield (kg/ha)			Second crop yield (kg/ha)			Pea equivalent yield (kg/ha)		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
Pea-mustard 'NDRE 4'	5560	4418	4989	520	614	567	6080	5042	5561
Pea-mustard 'JD 6'	5390	4362	4876	430	549	490	5820	4891	5356
Pea-toria 'Bhawani'	5420	4399	4910	309	355	332	5729	4748	5239
Pea- local sarson 'Yungar'	5380	4357	4869	240	243	242	5620	4594	5107
Pea-renchbean 'Contender'	5490	4457	4974	1517	1570	1544	6754	6000	6377
Pea-buckwheat 'Local'	5360	4383	4872	165	94	130	5470	4478	4974
Pea-buckwheat 'USDA'	5410	4430	4920	22	56	39	5410	4507	4959
LSD (P=0.05)	NS	NS	NS	-	-	-	123.9	88.9	72

**Table 3.** Productivity and economics of pea based cropping sequences under dry temperate conditions in north western Himalayas

Cropping sequence	Productivity efficiency (kg/ha/day)	Net return (INR/ha)	Profitability (INR/ha/day)	B:C Ratio
Pea-mustard 'NDRE 4'	15.2	81,478	223	1.86
Pea-mustard 'JD 6'	14.7	76,913	211	1.76
Pea-toria 'Bhawani'	14.4	73,395	201	1.68
Pea- local sarson 'Yungar'	14.0	70,063	192	1.60
Pea-Frenchbean 'Contender'	17.5	86,714	238	1.82
Pea-buckwheat 'Local'	13.6	68,406	187	1.61
Pea-buckwheat 'USDA'	13.6	66,914	183	1.57
LSD (P=0.05)	-	-	-	-

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