

Performance of potato (*Solanum tuberosum*)—vegetables intercropping systems under dry-temperate conditions of north-western Himalayas

SURESH MALHOTRA¹ AND NAVEEN KUMAR²

Research Sub-Station, Himachal Pradesh Krishi Vishvavidyalaya, Lari Spiti, 172 113

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ABSTRACT

A field experiment was conducted during summer 1991 and 1992 to study the compatibility of different vegetable crops with potato (*Solanum tuberosum* L.) for maximizing production and income of intercropping systems under dry-temperate conditions. The yield of all the crops was highest in sole stand than in intercropping system. Pure crop of potato gave the highest tuber yield of 128.1 and 127.1 q/ha during 1991 and 1992 respectively. Maximum reduction in potato yield was noted in potato + turnip [*Brassica rapa* (L.) Thell. emend. Metzger]. Sole crop of cabbage [*Brassica oleracea* L. convar. *capitata* (L.) Alef. var. *capitata* L.] gave the highest net return of Rs 87,520 and 86,666/ha after during 1991 and 1992 respectively. Intercropping of potato + cabbage was more productive (255.1 q/ha potato-equivalent yield) and more remunerative (net return of Rs 48,319 and 44,570/ha). These net returns were 213.15 and 201.21% higher than net return under sole potato respectively. Highest land-equivalent ratio of 1.31 was in potato + radish [*Raphanus sativus* L.], followed by potato + cabbage (1.13).

Potato (*Solanum tuberosum* L.) is a main cash crop of the Spiti valley. Area is characterized by dry-temperate climatic conditions with calcareous sediments, which also provides good scope for off-season vegetable production (HPKV, 1990). It was envisaged that other vegetable crops could be grown simultaneously with potato crop. The intercropping assures stable production. An adoption of appropriate planting pattern in various crops may result in increased total productivity. Since information on intercropping of potato with different vegetable crops is not available under dry-temperate climatic conditions, an attempt was made to study the compatibility of other vegetable crops as intercrop in potato. The objective

was to quantify the effect of intercrop on the base crop in addition to the effect on the production.

MATERIALS AND METHODS

A field experiment was conducted during the summer season 1991 and 1992 at Research Sub-Station, Lari (Spiti). The soil was silty clay loam in texture, low in available N (119 kg N/ha), P (8 kg P₂O₅/ha) and high in K (512 kg K₂O/ha) and alkaline in reaction (pH 7.6). The experiment was laid out in randomized block design with 13 cropping systems, replicated 3 times. The crops of 'Kufri Chandramukhi' potato, 'POI' cabbage [*Brassica oleracea* L. convar. *capitata* (L.) Alef. var. *capitata* L.],

Present address: ¹KVK, CCS HAU, Kurukshetra; ²Department of Agronomy HPKV, Palampur 176 062

'PTWG' turnip [*B. rapa* (L.) Thell. emend. Metzger], 'RRWT' radish (*Raphanus sativus* L.), 'Solan Selection' chinese cabbage (*B. chinensis* L.), 'Black Seeded' lettuce (*Spinacia oleracea* L.) and 'Arkel' pea (*Pisum sativum* L. sensu lato) were planted at row spacing of 60, 60, 30, 30, 60, 60, and 30 cm respectively. The intercrops were planted in between the 2 rows of potato maintaining optimum stand as that of sole stand.

The sowing of potato, radish, turnip and pea was done during the second week of May. Cabbage, Chinese cabbage and lettuce were transplanted during the first week of July. Recommended doses of fertilizers were applied to each crop in sole stand, whereas in intercropping systems no supplementary fertilizers were given to intercrops.

Irrigations were given as and when required. Potato-equivalent yields were worked out on the basis of prevailing local prices. Records of the inputs were maintained to work out the cost of cultivation and returns.

RESULTS AND DISCUSSION

Potato yield

The general yield levels were almost similar during both the years (Table 1). Pure potato gave the highest tuber yield of 128.1 and 127.1 q/ha during 1991 and 1992 respectively. Reduction in yield was noted under intercropping of vegetables with potato to 39.1–54.1 q/ha. The tuber yield of potato was lowest in potato + turnip intercropping. Tuber yield of potato grown in association with root crops was reduced to 54.1 q/ha and that of due to leafy vegetables to 37.4 q/ha. The lower yield of potato in intercropping of root crops may be due to more competition in the root zone. Singh and Rathi (1984) also obtained 6% reduction in potato yield

with intercropping of Indian mustard.

Intercropping of potato + Chinese cabbage gave the highest tuber yield after a sole potato during both the years. The higher yield under this system may be because that potato + Chinese cabbage remain in competition only for 35 days compared with other crops and potato crop could utilize the space leftover after the harvest of associated Chinese cabbage that helped in better tuber yield.

Intercrop yield

The yields of intercrops were low in intercroppings as compared with their sole stands. Cabbage yielded higher than other intercrops, whereas pea gave the lowest yield. The competition for 95 days in potato + pea might have reflected toward the lower yield of pea. The lower yields of root crops in mixed stand may be attributed to more competition in the root zone. In case of leafy vegetables lower yield may be due to more competition for space.

Potato-equivalent yield

The potato-equivalent yield was significantly affected by different intercepting systems during both the years. The highest tuber yield of 354.6 q/ha was computed in sole cabbage. Among the different intercropping systems, potato + cabbage computed highest tuber yield of 255.1 q/ha, which was higher by 127.5 q/ha than pure potato. This might be due to higher yield of cabbage under intercropping systems.

Land-equivalent yield

The higher land-equivalent ratio was recorded with potato + radish (1.31), followed by potato + cabbage (1.13) and potato + lettuce (1.04). This indicates the greater biological efficiency of intercropping treatments. The lowest land-equivalent ratio was

Table 1. Yield and economics of potato and intercrops as influenced by different intercropping systems

Treatment	Potato yield (q/ha)			Intercrop yield (q/ha)			Potato-equivalent yield (q/ha)			LER	Mean competition period (days)	Net return (Rs/ha)	
	1991	1992	Mean	1991	1992	Mean	1991	1992	Mean			1991	1992
Sole potato	128.1	127.1	127.6							1.00		15,430	14,797
Sole cabbage				266.3	264.6	265.5	356.5	352.8	354.6	1.00		87,520	86,666
Sole turnip				239.2	235.4	237.3	159.5	156.9	158.2	1.00		38,060	36,940
Sole radish				71.6	73.5	72.6	47.7	49.0	48.4	1.00		4,320	4,328
Sole Chinese cabbage				100.7	97.4	99.1	67.1	64.9	66.0	1.00		5,890	4,593
Sole lettuce				70.0	71.9	71.0	46.7	47.7	47.3	1.00		2,712	2,593
Sole pea				67.2	65.0	66.1	134.3	130.0	132.2	1.00		27,650	25,791
Potato + cabbage	83.2	80.7	82.0	131.2	128.4	129.8	258.1	251.9	255.1	1.13	61	48,319	44,570
Potato + turnip	74.0	73.0	73.5	83.6	82.5	83.1	129.7	128.2	129.0	0.93	75	32,561	30,900
Potato + radish	75.6	76.2	75.9	47.4	48.2	67.8	107.2	108.3	107.8	1.31	72	13,000	12,773
Potato + Chinese cabbage	89.4	87.7	88.5	40.1	41.3	40.7	116.1	115.2	115.7	0.96	35	8,040	12,773
Potato + lettuce	84.6	81.9	83.2	32.1	32.1	32.1	106.0	103.3	104.7	1.04	41	6,333	4,980
Potato + pea	80.8	79.6	80.2	24.1	21.2	22.7	129.0	122.0	125.5	0.95	95	17,090	13,850
CD (P = 0.05)	4.18	3.18	3.58				17.986	18.24	18.17				

LER, Land-equivalent ratio

Price (Rs/ha): Potato 300; cabbage 400; turnip 200; radish 300; Chinese cabbage 200; lettuce 200; pea 800

noticed with potato + turnip.

Net returns

The highest net return of Rs 87,520 and Rs 86,666/ha was recorded with sole cabbage in 1991 and 1992 respectively, followed by potato + cabbage, potato + turnip and potato + pea. Potato + lettuce intercropping system gave the lowest net returns.

It was concluded that under dry-temperate conditions potato and off-season vegetable can be grown successfully during

summer months. Among the different intercropping systems potato + cabbage, potato + turnip and potato + pea are the most profitable intercropping systems of the area.

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