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RESEARCH ARTICLE

Response of Young 'Misri' Sweet Cherry Trees to Orchard Floor Management

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Abstract

A field experiment was conducted to evaluate the response of young 'Misri' cherry trees, grafted onto Colt rootstock, to orchard floor management practices using different intercrops. Those vegetative covers evaluated were legumes such as pea (nutrient providing) red clover, French bean and, heavy feeder (requiring higher level of soil nutrients) crop types of maize, oats, cabbage and strawberry compared to a clean cultivation which was kept control. Growth of young 'Misri' (Bigarreau Noir Gross) on Colt rootstock cherry trees during 2008 and 2009 was significantly affected by the vegetative intercrops. Cherry trees intercropped with leguminous crops, such as pea, red clover and french bean, had greater tree growth as measured by annual extension shoot growth, tree girth, height and spread than those under clean cultivation and heavy feeder crops like oats and maize. Yield, leaf nutrient status (N, P, K, Ca, Mg) and relative economic yield (system equivalent yield) of cherry trees intercropped with pea, red clover and French bean were greater than clean cultivation. However, lowest yield and yield related characters like (Fruit no. Fruit weight and Fruit volume), leaf nutrient status and economics in terms of Benefit:Cost ratio were lower in cherry trees with maize, oats and strawberry.

INTRODUCTION

Cherry (*Prunus avium* L.) is one of the most important fruit grown in the temperate regions (Kabu *et al*., 1982). It belongs to the *Rosaceae* family and is believed to originate from the region between the Black and Caspian sea (Westwood, 1993). The global cherry production is estimated to be 20,69,595 m tonnes obtained from an area of 3,68,524 ha (FAO, 2012). In India, the state of Jammu and Kashmir, Himachal Pradesh and Uttarakhand are the main contributors of cherry production in which Jammu and Kashmir alone produces more than 95 per cent of the worlds (2069595mt) total production of commercial cherries. An area of 3600 ha is under cherry cultivation in J&K with an annual production of 15300 metric tonnes (Anonymous, 2012). However, in many areas cherry orchards are located in steep sites which are more vulnerable to runoff and soil erosion. Moreover, rains and snow during winter are generally followed by drought or minimal rainfall in the summer. As such, it becomes essential to develop strategies to improve soil physical properties that conserve soil moisture and moderate soil temperature to improve tree growth, and yield of the orchards. So Orchard floor management practices appear to be one of the most important operations in successful orchard management to attain these goals. It can affect tree growth, cropping, fruit quality and tree nutrition, through its effect on the nutrient and moisture availability and improving the soils physical properties. However, sufficient information on different floor management practices in cherry orchards, their relative efficiency and economic use in profitable cherry production is lacking. Therefore, the studies were

conducted to determine the Growth, Quality,Leaf nutrient status, Economic potential of Cherry under different floor management practices.

MATERIALS AND METHOD

The experiment was conducted on nine year old bearing cherry tress grafted onto Colt rootstock at Ambri Fruit Research Station, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Pahnoo, Distt. Shopian, J&K, India during 2008 and 2009. The plants were spaced at 4m x 4m apart. Intercultural operation was done on 4 plants per plot with plot size of $16m^2$ (square type). Initial soil status of experimental orchard was analysed for various physico-chemical characteristics such as Soil ph, Electrical conductivity, Available N, P, K, Ca and Mg. The experiment was laid out as a Randomized Block Design with three replications and eight treatment such as maize, pea, strawberry, cabbage, french bean, red clover, oats and clean cultivation (control). The growth parameters measured were viz. annual extension growth of shoots, plant girth, plant height and plant spread. These parameters were measured by measuring tape before and after commencement of experimentation during both the years. Data on yield parameters were recorded as percent fruitset calculated at fruitlet stage by using the formula suggested by Westwood (1993). Yield of intercrops (qt/ha) was estimated after harvesting the crops and sold them to nearby market as per the rates estimated by the Local market. Floral characteristics like initial bloom (10%) and full bloom (80%) were recorded. The recorded dates were converted into days after reference date which was fixed arbitrarily as March 1^{st} (Julian date). Fruit maturity was recorded from the date of full bloom to the date when the fruit was harvested. Fruit yield was recorded by weighing total fruits obtained from each experimental plant . Leaves of middle portion of the branches from all sides of the tree were collected (25 leaves from each tree) during July-August and then washed, dried and grinded. After that samples were analysed for Leaf total nitrogen, determined by Micro-Kjeldhal method (A.O.A.C., 2007), total phosphorus by Vandomolybedate phosphoric yellow colour method (Jackson, 1967) and total potassium by flame photometer (Merwin and Peech, 1950). Ca^{2+} and Mg^{2+} ions in leaf were determined by Atomic Absorption Spectrophotometer. The nutrients estimated were expressed as percent on dry weight basis. Economics of all the treatments were worked out in terms of Benefit:Cost ratio as determined by Bhuva *et al.* (1988). The data was subjected to statistical analysis as per Snedecor and Cochran (1989) Statistical methods.

RESULTS AND DISCUSSION

The data presented in Table-I revealed that growth parameters of annual extension growth, plant girth, plant height and plant spread were significantly influenced by the use of intercrops. Cherry trees intercropped with pea followed by red clover and French bean had higher annual extension growth, plant girth, plant height and plant spread than cherry trees with clean cultivation (control) and heavy feeder crops (requiring high level of soil nutrients) like strawberry, cabbage, oats and maize. This might be due to the timely availability of nutrients particularly nitrogen, phosphorus, potassium and calcium from leguminous crops, which are essential for growth and development while in case of control i.e. vegetation free area all these growth parameters were found slightly higher than heavy feeder crops. This indicates that vegetation free area also promote cherry tree growth compared to complete vegetation under tree. These findings are in conformity with Stiles (1994) and Chifflot *et al.* (2006). Growth parameters particularly (Annual extension growth) was recorded highest in cherry trees with leguminous crops than cherry trees intercropped with heavy feeder crops(requiring high level of soil nutrients) like cabbage, oats and maize. It is also an important consideration with young cherry trees that if moisture stress occurs it results in premature terminal bud set. Once the terminal bud is set, no further shoot elongation occurs and tree size is reduced resulting in less cropping surface in future years. These findings are in line with Stiles and Shaw (1991). Average time of attaining initial bloom, full bloom, per cent fruitset stages and fruit maturity was earlier in cherry trees intercropped with leguminous crops like pea followed by red clover and French bean than clean cultivation (control). However, more number of days were taken to first flower by the trees which were intercropped with heavy feeder crops like cabbage, oats and maize. This difference may possibly be due to the reason that legumes enrich the soil with N and enhances the timely availability of nutrients while heavy feeder crops like oats and maize restricts the uptake of nutrients. These results are in conformity with Sanchez *et al.* (2003). So due to the deficiency of nutrients opening of buds occur slowly taking more time to come into full bloom thus enhancing the number of days to mature fruits. These results are in full agreement with Westwood (1988).

Date presented in Table-II revealed that leguminous crops under cherry trees recorded higher fruit set than heavy feeder intercrops (oats and maize). This may be due to physical improvement of soil which might have facilitated

the development of roots of plants and provided better conditions for uptake of nutrients. These results find support form Guerrero-Prieto *et al*. (1985).

TABLE I: Effect of intercrops on annual extension growth, plant height and plant spread in cherry cv. Misri

	Treatment	Increment of plant girth (cm)			Annual extension growth (cm)			Increment of plant height (cm)			Increment of plant spread (cm)		
		2008	2009	Pooled	2008	2009	Pooled	2008	2009	Pooled	2008	2009	Pooled
T_1	Maize	1.2	1.3	1.2	44.05	46.06	44.85	25	27	26	38	40	39
T_2	Pea	2.2	2.4	2.3	53.70	56.09	55.80	60	64	62	61	62	61
T_3	Strawberry	1.5	1.6	1.5	48.47	50.18	49.22	39	42	40	45	47	46
T_4	Cabbage	1.4	1.5	1.4	47.10	49.51	48.73	37	39	42	42	44	43
T_5	Red clover	2.0	2.2	2.1	52.44	55.09	54.76	56	58	55	57	59	58
T_6	French bean	1.8	2.0	1.9	51.82	54.79	53.48	52	54	53	53	55	54
T_7	Oats	1.3	1.4	1.3	46.04	48.94	47.96	31	32	33	40	42	41
T_8	Clean cultivation (control)	1.6	1.7	1.5	50.75	52.08	50.82	48	50	49	50	52	51
	CD (P≤ 0.05)	0.03	0.05	0.01	**0.73**	**0.42**	**0.42**	**0.15**	**0.32**	**0.12**	**0.11**	**0.23**	**0.10**

TABLE II: Effect of intercrops on initial bloom, full bloom and percent fruit set in cherry cv. Misri

Treatments	Initial bloom (days) after reference date (1st March)	Full bloom (days) after reference date (1st March)	Percent fruit set

		2008	2009	Pooled	2008	2009	Pooled	2008	2009	Pooled
T_1	Maize	37.81	38.25	38.03	42.15	43.22	42.68	10.00	11.00	10.49
T_2	Pea	32.05	33.72	32.88	36.88	37.75	37.31	12.09	13.33	12.48
T_3	Strawberry	35.79	36.81	36.30	40.57	41.99	41.28	10.33	11.31	11.82
T_4	Cabbage	36.72	37.91	37.31	41.47	42.09	41.78	10.10	11.09	10.60
T_5	Red clover	33.57	34.82	34.19	37.75	38.80	38.27	11.33	12.60	11.97
T_6	French bean	34.86	35.71	35.28	38.74	39.90	39.32	11.00	12.35	11.66
T_7	Oats	37.57	38.03	37.80	42.00	43.08	42.54	10.07	11.01	10.51
T_8	Clean cultivation (control)	35.65	36.05	35.85	39.05	40.17	39.61	10.50	11.83	11.18
CD (P≤0.05)		**0.22**	**0.32**	**0.14**	**0.12**	**0.88**	**0.05**	**0.32**	**0.24**	**0.26**

TABLE III: Effect of intercrops on fruit maturity and fruit yield in cherry cv. Misri

Treatments		Fruit maturity (DAFB upto the date of harvesting)			Fruit yield (kg/tree)		
		2008	2009	Pooled	2008	2009	Pooled
T_1	Maize	74.72	75.99	75.36	14.00	15.60	14.90
T_2	Pea	69.22	70.08	69.97	16.84	17.75	17.30
T_3	Strawberry	72.95	73.85	73.45	15.18	16.20	15.70
T_4	Cabbage	72.69	73.70	73.20	14.75	15.35	15.09

T_5	Red clover	69.75	70.70	70.22	16.50	17.53	17.04
T_6	French bean	70.89	71.58	71.24	16.15	17.33	16.75
T_7	Oats	73.57	74.78	74.18	14.10	15.66	14.89
T_8	Clean cultivation (control)	71.72	72.96	72.36	15.55	16.40	15.98
CD (P≤0.05)		**0.42**	**0.60**	**0.26**	**0.32**	**0.21**	**0.11**

TABLE IV: Effect of intercrops on leaf nutrient status in cherry cv. Misri

Treatments		**Nitrogen (%)**			**Phosphorus (%)**			**Potassium (%)**		
		2008	**2009**	**Pooled**	**2008**	**2009**	**Pooled**	**2008**	**2009**	**Pooled**
T_1	Maize	2.40	2.50	2.46	0.162	0.170	0.167	1.79	1.81	1.80
T_2	Pea	2.66	2.75	2.72	0.185	0.193	0.190	1.95	1.98	1.97
T_3	Strawberry	2.51	2.63	2.58	0.178	0.186	0.183	1.87	1.91	1.90
T_4	Cabbage	2.48	2.56	2.53	0.176	0.184	0.182	1.85	1.88	1.87
T_5	Red clover	2.62	2.70	2.67	0.208	0.216	0.213	2.06	2.09	2.08
T_6	French bean	2.58	2.64	2.62	0.191	0.199	0.196	2.00	2.03	2.02
T_7	Oats	2.43	2.52	2.48	0.170	0.178	0.175	1.81	1.84	1.83
T_8	Clean cultivation (control)	2.54	2.64	2.59	0.180	0.187	0.184	1.90	1.93	1.92
CD (P≤0.05)		**0.03**	**0.04**	**0.02**	**0.011**	**0.027**	**0.013**	**0.05**	**0.04**	**0.02**

TABLE V: Effect of intercrops on leaf nutrient status in cherry cv. Misri

Treatments		Calcium (%)			Magnesium (%)		
		2008	2009	Pooled	2008	2009	Pooled
T_1	Maize	2.23	2.25	2.24	0.20	0.22	0.21
T_2	Pea	2.38	2.40	2.39	0.40	0.43	0.41
T_3	Strawberry	2.31	2.33	2.32	0.28	0.30	0.29
T_4	Cabbage	2.28	2.30	2.31	0.26	0.28	0.27
T_5	Red clover	2.48	2.50	2.49	0.36	0.39	0.38
T_6	French bean	2.43	2.45	2.44	0.34	0.37	0.36
T_7	Oats	2.26	2.28	2.27	0.22	0.24	0.23
T_8	Clean cultivation (control)	2.33	2.35	2.34	0.31	0.33	0.32
CD (P≤0.05)		**0.04**	**0.02**	**0.01**	**0.03**	**0.02**	**0.01**

TABLE VI: Effect of intercrops on relative economic yield of cherry cv. Misri

Treatment		Pooled cherry yield (kg/ha)	Yield of intercrop (q/ha)	Income obtained from intercrops (Rs.)	Cherry equivalent intercrops yield (kg/ha)	Total system yield (kg/ha)	Total cost of cultivation (Rs.)	Gross return (Rs/ha)	Net return (Rs./ha)	Benefit cost Ratio
T_1	Maize	3874.00	35	28000	466.60	4340.60	120426.00	260436	140010	1.16
T_2	Pea	4498.00	23	57500	958.30	5456.30	140550.00	327379	186829.9	1.32

T_3	Strawberry	4082.00			2300.00	6382.00	177582.00	255280	77698.00	0.44
i)	Fruit		13	52000						
ii)	Runner		40,000	40000						
T_4	Cabbage	3923.40	1.35	81000	1350	5273.40	138620	316404	177784	1.28
T_5	Red clover	4430.40	110.00	11000	1833	4613.70	145837	276823	130986.9	0.89
T_6	French bean	4355.00	22	55000	916.60	5272.00	150550	316296	165746	1.10
T_7	Oats	3871.40	210	21000	350.00	4221.40	121729	253284	131555	1.08
T_8	Clean cultivation (control)	4154.80	-	-	-	-	130000	249288	119288	0.91

*Maintenance cost of established orchard Rs. 5,000/Kanal.

The data presented in Table-III recorded that average fruit yield was higher in cherry trees intercropped with pea followed by red clover, French bean, clean cultivation (control), strawberry, cabbage and oats. However, lowest yield in cherry trees was recorded with maize. This might be due to the reason that cherry trees intercropped with leguminous crops (pea, red clover and french bean) improved the physical conditions of soil thereby enhancing the uptake of nutrients and improved the moisture conditions of soil. Since yield is a dependent variable, mainly depends upon the number of fruit/plant, fruit weight and fruit size. All of these parameters were recorded highest in cherry trees intercropped with leguminous crops than heavy feeder crops like oats and maize. These findings are in congruence with Funke (1982) and Jadczuk and Sadowski (1997).

The data presented in Table-IV and Table-V recorded that the highest leaf N and Mg contents were in cherry trees with pea, followed by red clover, french bean, clean cultivation (control), strawberry, cabbage and oats. However, lowest leaf N and Mg were recorded in cherry trees intercropped with maize. This might be due to the reason that leguminous crops have a symbiotic relationship with *Rhizobium* species which is capable of fixing large amount of atmospheric N and thus increasing available soil N (Hoagland *et al*., 2008), while clovers increases the infiltration capacity of soils which enhances uptake of nutrients particularly those whose movement occurs with mass flow e.g. magnesium. These observations are in agreement with Fisenko (1969) and Kenworthy (1954) and Shylla and Chauhan (2004). Highest leaf P, K and Ca contents were recorded in cherry trees intercropped with red clover and lowest was recorded in cherry trees with maize. This is due to the reason that clovers not only increase the infiltration capacity of soils,(Stinchcombe and Stott., 1983) but they can draw the nutrients from deeper layers of soils and make it available to the plants, Xinhua *et al.* (2007). These observations are also in line with Sirrine *et al.* (2008) who observed that ground cover management system significantly influenced the yield ,leaf nutrient status, nutrient uptake and reserve nitrogen in ground and permanent tissues from previous growth cycles. Besides this, in late summer and autumn trees move nitrogen and other nutrients from annual tissues to perennial tissues. Remobilizatioin of these reserves from woody tissues is the main driver of early season fruit, leaf nitrogen and leaf growth and has been correlated with leafy canopy management also.

Cherry trees intercropped with red clover accumulated highest leaf K and Ca than intercropped with maize. As uptake of K and Ca require adequate soil moisture which is made available to the cherry trees with clovers while intercropping with maize resulted in lowest leaf K and Ca which is attributed to the competition of this crop with cherry trees as maize removes a large amount of moisture and nutrients from the soil and also transpire more leading to surface sealing of soil and compactness which restricts the uptake of nutrients, Weikai *et al*. (1999). These results are also in conformity with Neilson and Hogue (1985) Claypool (1975) and Dris *et al.* (2002).

Highest benefit : cost ratio was recorded in cherry trees intercropped with pea followed by cabbage and french bean. This was mainly due to higher yield, better marketing prices and net income obtained from these intercrops, while other treatments also appeared to be economical in view of Benefit:Cost ratio (Table-VI). These results are in line with Bhuva *et al.* (1988) and Kishore *et al*. (1997).

From the foregoing discussion, it can be concluded that use of leguminous crops have improved the growth, yield and leaf nutrient status of cherry trees. Cherry trees also exploited their potential better under clean cultivation practices than other orchard floor management and use of clovers as companions crop have improved the infiltration and water holding capacity of soils by the formation of soil pores, which in addition to enhancing soil macrofauna habitat also provides pathways for water to filter through the soil profile rather than draining off the field as surface flow

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