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Effect of Fertilizer Application on Plant Growth and Fruit Yield of *Salvadora persica* Plantation on Salt Affected Soil in Arid Rajasthan

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ABSTRACT

S. persica is a preferential halophyte, evergreen multipurpose tree species grows widely on arid salt affected lands in Rajasthan, Gujarat, Haryana and Punjab states of India (6.73 M ha). Realizing the potentials, management practices viz., Farm yard manure, gypsum and nitrogen, for its establishment were worked out earlier. Experimental site is located on a hummocky, sandy plain. Soils are coarse sandy to loamy sand, underlain by hard, compact, pan of calcium carbonate at 75-100 cm depth. The substratum is impervious to roots and water. Incremental tree growth was minimal after ten years. Thirteen fertilizer combinations consisting of control, FYM, N, P K and Zn were applied in Random Block Design in three replications in January, 2009. After three years all the treatments recorded better incremental growth as compared to control. Phosphorus application with FYM either alone or with other inorganic fertilizers was most effective. Maximum height increment was 35.9% in T_{12} (FYM + K_2SO_4 + SSP) and T_9 (FYM + Urea + SSP) treatments, crown growth in T_{13} (FYM + K_2SO_4 + SSP + Urea + $ZnSO_4$), T_{12}, T_9, and T_6 (FYM + SSP) treatments (ranging from 40 to 51%). For collar girth, four treatments [T_{12}, $T_{13,}$ T_{11} (FYM + $ZnSO_4$ + SSP) and T_6] recording more than 50% incremental growth contain phosphorus either alone or with other elements. Fruit yield was influenced by rainfall also. After deficient monsoon, the mean fruiting was observed in 24.2% trees only in April, 2010. Zinc application influenced the fruit yield and per tree yield was more in T_4 (341g), T_7 (334g) and T_{13} (243.7g) followed by in T_3 (123g). After above average monsoon (562 mm), mean fruiting tree percentage was 49.5% (nil –T_1 to 77.8% in T_2 and T_{11} treatments) in 2011. T_{12} was the best treatment recording maximum overall fruit yield of 1.25 kg (207 g/tree) closely followed by T_{13} (1.20 kg; 240 g/tree) and T_8 (1.10 kg; 353g/tree), respectively indicating the positive influence of Potassium with Phosphorus. While most trees have mixed colored (purple, white and pink) fruits, few trees yielded only white colored fruits every year.

Key Words: Halophyte; Miswak; Farm Yard Manure; Nitrogen; Phosphorus; Potassium

INTRODUCTION

Salvadora persica (L), popularly known as miswak, toothbrush tree or khara jal, belonging to family Salvadoraceae, is an important salt tolerant native tree species on arid salt affected lands in Rajasthan, Gujarat, Punjab and Western Uttar Pradesh (Anon. 1986). It is a preferential halophyte that stores excess salts in mature and senescent leaves and in the bark which, when shed, remove excess salts (Amonkar and Karmakar 1978). It has multifarious uses: twigs and young stems as a toothbrush; shoots as camel fodder; plant ash as salt, bark for suppressing the bacterial growth and plaque formation in mouth; back pains, chest diseases, and stomach aches. Seeds are used as a tonic and seed oil is rubbed on the skin for rheumatism. Seed is rich in oil and contains lauric, myristic, and palmitic acids with potential for making soaps, candles, and as a substitute for coconut oil (FAO 1986, Hallawany 2012). It is planted in saline coastal area (Makwana et al. 1988). Realizing the potentials, management practices for establishment of this tree species were worked out (Arya et al. 2005, Arya and Lohara 2005). Application of nitrogen with gypsum gave better growth, 41% for height and 35% for crown diameter compared to un-treated plants. The tree is very slow growing, treatment effect declined after 6 years and incremental growth was very less. Present study was taken up to boost the growth of

ten year old plantation of *S. persica*, with the application of FYM along with different inorganic fertilizers in January 2009. The effects on growth and fruit yield after three years of studies are presented here.

STUDY AREA

The study was made in Gangani village (Latitude 26° 50' N, Longitude 73°21' E) of Jodhpur district of Rajasthan.

Land Forms and Soils

The experimental site is located on a hummocky, sandy plain. Soils are coarse sandy to loamy sand, underlain by hard, compact, pan of calcium carbonate at 75-100 cm depth. The substratum is impervious to roots and water. These soils have been classified as coarse loamy Haplocalcids. The soil is low in organic carbon (0.1 to 0.2 %), nitrogen and phosphorus (CAZRI 1999). The soil of the experimental site was classified as a lithic, calcid, coarse sandy to loamy sand, underlain by a thick hard pan of calcium carbonate at a depth of 25-100 cm. Initial soil properties (pH, EC and % SOC) analysed in May 2008 before the ten years of plant growth are summarized in Table 1.

Table 1. Physicochemical soil status in summer 2008

Soil depth (cm)	pH_2	EC, dS m^{-1}	SOC, %
0-25	8.15-8.56	0.43-3.07	0.10-0.15
25-50	8.29-8.54	0.51-2.25	0.09-0.12
50-75	8.46-8.74	0.82-1.78	0.02-0.12

Climatic Conditions

The mean annual rainfall of the site is 350 mm, which is mainly confined to the monsoon period (from July to September). The total number of rainy days during the year varies from 8 to 17 days. The maximum temperature rises as high as 50 ^{0}C in summer and minimum drops to 4 ^{0}C in winter. Average wind velocity in the summer months is recorded as 15 to 25 km h^{-1} (Arya et al 2005). The climatic conditions of the experimental site during the experimental period are summed up in Tables 2a and 2b.

Table 2a. Rainfall data of the experimental area during the study period

Months	**2008**	**2009**	**2010**	**2011**	**2012**
January	Trace	0.0	1.5	0.0	0.00
February	Trace	0.0	0.5	14.8	0.00
March	1.6	2.8	0.0	0.0	0.00
April	24.6	0.4	0.2	0.0	29.2
May	91.4	21.6	0.0	0.3	2.1
June	97.5	21.4	45.4	0.0	17.7
July	66.2	115.2	133.9	92.3	11.7
August	138.8	44.1	120.7	118.8	291.1
September	13.8	6.5	202.9	93.8	132.8
October	Trace	0.0	0.0	0.3	0.00
November	0.0	0.0	39.8	0.0	0.00
December	3.8	0.0	17.3	0.0	0.00
Total	**437.7**	**212.0**	**562.2**	**320.3**	**484.6**

STUDY METHODS

Thirteen different fertilizer combinations as given below were applied in a randomized block design having three replications. There were three plants in each treatment and the original spacing of 3 x 4 m was maintained.

T_1: Control,
T_2: FYM (10 kg $plant^{-1}$)
T_3: FYM + Urea (250 g N),
T_4: FYM + $ZnSO_4$ (40 g Zn),
T_5: FYM + K_2SO_4 (50 g K_2O),
T_6: FYM + SSP (200 g P),
T_7: FYM + Urea + $ZnSO_4$,
T_8: FYM + Urea + K_2SO_4,
T_9: FYM + Urea + SSP,
T_{10}: FYM + $ZnSO_4$ + K_2SO_4 ,
T_{11}: FYM + K_2SO_4 + SSP + Urea + $ZnSO_4$,
T_{12}: FYM + K_2SO_4 + SSP,
T_{13}: FYM + $ZnSO_4$ + SSP

A plant bowl of 2 m diameter was made around individual plant stem and 10 kg FYM was mixed with pit soil in August 2008. Due to insufficient rainfall, inorganic fertilizers were mixed in January 2009 with 40 L of irrigation per plant and further irrigation was given in February 2009 after one month. No irrigation was provided after that during the entire study and the plantation was maintained as rainfed.

Table 2b: Periodic temperature (^{0}C) range during the experimental period

	2008		**2009**		2010		**2011**		2012	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
January	23.4	10.7	25.7	12.3	26.3	10.9	24.5	9.1	23.3	19.3
February	26.3	9.6	29.8	14.5	29.5	13.8	27.5	13.6	26.4	11.8
March	36.1	8.4	35.4	19.7	36.2	20.5	35.0	18.4	33.8	16.9
April	28.1	22.9	38.9	22.7	41.3	26.4	38.7	22.8	38.4	23.4
May	38.8	25.9	42.6	29.2	43.4	29.5	41.4	28.2	41.6	27.4
June	37.7	28.1	40.0	28.7	40.6	28.9	41.0	29.8	39.9	28.4
July	36.3	27.5	36.9	27.7	37.2	27.8	37.1	27.6	37.7	28.5
August	33	25.4	36.1	27.1	33.6	26.4	34.0	26.4	33.0	25.6
September	35.8	25.4	38.2	25.9	33.8	23.7	32.9	24.0	33.5	24.6
October	37.4	20.6	36.8	20.9	36.5	21.0	36.0	19.3	35.7	19.0
November	32.5	15.8	30.9	16.3	29.1	17.5	33.2	16.7	31.3	14.1
December	28	14.3	27.2	13.9	25.1	9.9	27.5	11.8	26.8	11.6

Plant Growth Measurements

Survival, height, crown diameter and quadratic collar diameter were recorded annually. As plants were multi-branched, collar diameter was recorded with the help of vernier calipers and multiplied with pie to report the values as collar girth.

Cultural Operations

One weeding was undertaken every year in the months of October-November. Plants did not suffer with any major disease during the whole study period. Severe rodent infestation was observed in the month of March every year; therefore, annual standard rodent control measures were applied. No major harm to the plants was recorded but large scale burrowing, soil loosening and moisture loss was observed. Due to soil loosening trees fell during wind storm in March 2012.

Fruit/ Pod Yield Estimation

All the fruits/pods on all the trees every year were enumerated manually. As *S. persica* fruit is the only edible thing available during the summer, yield was drastically influenced by bird damage. Measures were taken to keep the birds away; in 2009 a person was hired to remove the birds with Gophan but it was not very successful. In 2010, mosquito nets (1.8 x 1.8 m) were used to cover the individual plants, which was relatively more successful. Mosquito nets made of nylon were used in 2010 and 2011.

Data Analysis

The observed data were analysed by one factor ANOVA to study the effect of treatments on various growth parameters. Critical difference (CD) values were also calculated to determine the effect of individual factor on survival and growth parameters.

RESULTS

There was no casualty and survival remained 100% throughout the study period in all the treatments.

Growth

The periodic absolute and incremental height, crown diameter and collar diameter data are summarized in Table 3. The overall data for a period from 2008 to 2011 indicate that application of fertilizers enhanced the incremental growth for all the parameters-viz height, crown diameter and collar girth. Minimum growth increment was recorded for height.

Height

The absolute height values were ranging from minimum 207.1 cm for T_3 to maximum 258.3 cm for T_9 treatment after three years of fertilizer application. However, for most other treatments it was ranging between 216.5cm to 237.1cm indicating that probably after attaining a certain

Table 3. Periodic height, crown diameter and collar girth (Mean ± SE) of *S. persica* Trial with different treatments

Treatments	Height (cm)			Crown diameter (cm)			Collar girth (cm)		
	2008	2011	Cum	2008	2011	Cum	**2008**	**2011**	**Cumulative**
T_1	171.6± 10.6	220.5± 12.9	26.53	180.5± 9.1	230.7± 15.4	27.74	20.8± 2.1	29.3± 1.9	40.19
T_2	177.2± 14.3	231.6± 0.9	30.71	185.5± 5.0	259.0± 9.2	39.54	20.3± 1.0	30.4± 0.0	49.75
T_3	162.7± 10.3	207.1± 11.5	27.28	164.9± 8.5	222.5± 16.9	34.85	18.4± 2.4	25.9± 2.1	40.76
T_4	167.7± 13.9	217.7± 12.5	29.83	174.4± 5.8	250.3± 14.4	43.52	21.3± 0.5	32.2± 2.1	51.17
T_5	182.2± 6.7	217.2± 9.3	19.2	188.3± 6.0	250.8± 13.0	33.19	20.9± 1.7	30.3± 1.8	44.97
T_6	193.9± 5.3	231.1± 9.9	21.04	192.7± 6.4	270.2± 12.0	40.14	20.3± 0.5	30.8± 1.4	51.72
T_7	183.8± 13.8	237.1± 22.0	28.91	192.7± 21.0	263.7± 28.6	36.77	23.3± 2.5	33.1± 3.5	41.45
T_8	180.5± 6.4	234.4± 16.3	29.78	183.8± 20.8	255.6± 23.9	38.99	20.9± 2.5	30.3± 4.5	44.97
T_9	189.9± 7.5	258.3± 16.8	35.94	193.3± 1.6	290.7± 0.9	50.39	24.3± 1.9	36.4± 2.3	49.79
T_{10}	188.3± 10.1	236.6± 15.3	25.65	188.8± 3.9	251.7± 6.1	33.24	21.5± 2.3	32.2± 2.0	49.77
T_{11}	183.3± 25.3	233.3± 22.2	27.27	187.2± 33.6	259.7± 34.3	38.73	22.2± 5.4	33.7± 5.9	51.80
T_{12}	168.8± 10.6	229.7± 16.9	36.07	178.3± 5.3	268.7± 12.8	50.70	20.4± 1.4	32.8± 2.6	60.78
T_{13}	179.4± 14.5	225.5± 19.7	25.69	186.6± 17.3	283.3± 35.8	51.74	20.9± 1.8	33.1± 2.7	58.37
Mean	**179.2**	**228.9**	**27.99**	**184.4**	**258.2**	**39.96**	**21.2**	**31.6**	**48.9**
CD (5%)			**6.5**			**12.7**			**12.1**

height the incremental growth does not change much. Overall, height growth increment was less ranging from 35.9% in T_{12} and T_9 treatment to 19.2% in T_5 and T_6 treatments. Here, control with 26.5% increment was not the minimum. Treatment effect was significant (p-0.01) and T_{12} and $T_{9,}$ both containing phosphorous , attained significantly higher increment as compared to T_5, T_6, T_1, T_{10} and T_{13} treatments.

Crown Diameter

The absolute crown diameter values were ranging from 222.5 cm (T_3) to 290.7 cm in T_9 treatment after three years of fertilizer application. Treatments very significantly influenced the overall crown diameter growth (p-0.00) and all the treatments recorded higher crown increment ranging from 33.2% to 51.1% compared to control (27.7%). T_{13} (51.1%), T_{12} (50.5%), T_9 (50.4%) & T_4 (43.5%) recorded the maximum incremental crown diameter growth. Phosphorus application proved to be the most effective treatment as out of the first six high ranked incremental crown growth treatments five has phosphorus application, either single or in combination, with other elements. Application of Potassium alone or in combination with zinc was least effective.

Collar girth

In 2011 the absolute value of collar girth ranged from 25.9cm in T_3 to 36.4 cm in T_9 treatments, the incremental growth ranged from 41.0% in T_1 to 60.9% in T_{12} treatment, Data analysis indicates that treatment effect was highly significant (p-0.00). Though all the treatments recorded higher collar girth increment as compared to control but CD values indicate that except T_3, T_5, T_7 and T_8 its difference with all other treatment was not significant. The values for T_2, T_4, T_6, T_9, T_{10}, T_{11}, T_{12} and T_{13} were not much different with each other. Eight out of 13 treatments recorded more values than mean increment (48.9%). Overall values showed that for first four treatments contain phosphorus either alone or in combination with other elements.

Phenological Observations

Phenological observations recorded during the three years are summarized in Table 4. As per the literature the inflorescence is 10 cm long panicle that bears very small greenish to yellowish flowers. The fruit is pink to scarlet, spherical, fleshy, 5-10 mm in diameter. It contains one seed that turns pink to purple to semi transparent at maturity (Ecocrop 2011, Orwa et al. 2009). In India flowering occur from December - January to June. The

Table 4. Periodic Percent flowering and Final Fruit setting trees with different treatments

Treatments	2009				2010				2011				2012	
	A		B		A		B		A		B		A	
	Dec 2008	Feb	Early Maech	March end	Dec '09	Feb	March	March End	Oct '10	Jan	28 Feb	Mar-Apr	28 Feb	March
T_1	77.7	88.8	**100**	**44.4**	44.4	55.5	55.5	33.3	100	77.7	66.6	Nil	77.7	66.6
T_2	88.8	100	**100**	**44.4**	66.6	44.4	44.4	22.2	100	88.8	77.7	77.7	66.6	55.5
T_3	88.8	88.8	**100**	**33.3**	44.4	33.3	33.3	22.2	88.8	88.8	88.8	22.2	88.8	66.6
T_4	88.8	88.8	**100**	**22.2**	55.5	22.2	22.2	22.2	88.8	88.8	77.7	44.4	88.8	33.3
T_5	88.8	88.8	**100**	**33.3**	44.4	33.3	33.3	11.1	88.8	100	88.8	44.4	88.8	77.7
T_6	88.8	88.8	**100**	**22.2**	44.4	11.1	0	nil	100	100	100	55.5	77.7	22.2
T_7	88.8	100	**100**	**44.4**	55.5	33.3	33.3	22.2	88.8	100	100	55.5	88.8	66.6
T_8	100	100	**100**	**22.2**	66.6	33.3	33.3	22.2	88.8	88.8	88.8	33.3	77.7	44.4
T_9	77.7	77.7	**100**	**44.4**	77.7	55.5	55.5	22.2	100	88.8	88.8	66.6	88.8	66.6
T_{10}	66.6	66.6	**100**	**33.3**	66.6	33.3	0	nil	100	100	88.8	44.4	88.8	44.4
T_{11}	88.8	88.8	**100**	**44.4**	55.5	44.4	44.4	22.2	100	100	100	77.7	100	55.5
T_{12}	77.7	77.7	**100**	**33.3**	55.5	33.3	33.3	22.2	100	100	100	66.6	88.8	55.5
T_{13}	88.8	88.8	**100**	**77.7**	77.7	77.7	77.7	44.4	88.8	88.8	88.8	55.5	88.8	55.5
Mean	85.4	87.9	100	38.4	58.1	39.3	36.0	24.1	94.8	93.1	88.8	49.5	85.4	54.6

A= % flowering, B= seeded fruit initiation and final fruit setting

first fruit ripen in 3 months from flowering initiation (Janick and Paull 2008). Seedless fruits have been reported (Balasubramanium and Bole 1993).

However, in present study, flowering starts from early November to December and fruiting upto April-May depending on the rainfall and temperature. It revealed a very unique pattern. Initially, it flowers as very small greenish to yellowish flowers, in loose, slender-branched axillary or terminal panicles, up to 10 cm long. Afterwards small seedless, colored pulpy fruits formed. After 15-20 days normal fruit (with seed) formation initiated which are initially green in colour on the same branches and within a month ripening starts.

Phenological observations in 2009 recorded that after a slightly above monsoon rain (437.7mm) flowering was initiated in mid December and a mean of 85.4 % trees flowered in different treatments, seedless fruits were formed in all the trees. It increased to 87.4 % in February 2009 and 100% in early March 2009 (irrigation given to the trees may be the reason for it). In this year due to lack of bird protection measures the final fruit (with seed) setting was recorded in 38.4% trees only.

Phenological observations in 2010, recorded early flowering in 94.8% trees in second week of November, Seedless small fruit were formed but were either eaten by birds or dropped after 15-20 days. Second fruit setting was in total of 93.1% tree recorded in January, 2011. Fruit ripening took place in March. It is interesting to note that most trees have mixed colored (purple, white and pink) fruits but seven plants yielded only white coloured fruits, which is the first report. Three years observations indicated that plants with only white colour fruit yielded only white fruits in subsequent years also. Recently, Tahir et al. (2010) reported a new species of *S. persica* with white fruit as *S. alii* however, their morphological description is different from our species, therefore further careful observations should be recorded.

Observations in 2011-12 showed that the flowering was initiated in the month of Nov. 2011 and small seedless fruits were formed in 100% trees. Second fruit setting initiated in January 2012. A total of 85.5% tree flowered in the February 2012 and fruit ripening took place in March 2012 which is late as compared to 2011.

Fruit Setting and Yield

Periodic observations are summarized in Table 5.

In March 2009, final fruit setting was observed in 38.4% plants only. It was ranging from 22.2 % in T_4 T_6 & T_8 to 77.0% in T_{13} treatment. There was no effect of treatment. The maximum fruit yield per tree/treatment was 138.0g in T_8 followed by 108.0g in T_6, 100g in T_9 and minimum 45g in T_{11}.

Table 5. Periodic fruit yield estimation in different treatments

Treatments	2009			2010			2011		
	% Fruiting Trees	Fruit yield g tree^{-1}	Total Fruit yield	% Fruiting Trees	Fruit yield g tree^{-1}	Total Fruit yield	% Fruiting Trees	Fruit yield g tree^{-1}	Total Fruit yield
T_1	44.4	51	224	33.3	24	71	nil	nil	-
T_2	44.4	90	360	22.2	23	46	77.7	137	960
T_3	33.3	51	153	22.2	61.5	123	22.2	32	64
T_4	22.2	80	160	22.2	341	681	44.4	86	345
T_5	33.3	72	216	11.1	47	47	44.4	187	746
T_6	22.2	103	206	Nil	nil	Nil	55.5	135	673
T_7	44.4	75	300	22.2	334	668	55.5	122	610
T_8	22.2	138	276	22.2	10	20	33.3	353	1060
T_9	44.4	100	400	22.2	30	60	66.6	141	846
T_{10}	33.3	60	200	Nil	Nil	Nil	44.4	128	511
T_{11}	44.4	45	210	22.2	40	80	77.7	149	1040
T_{12}	33.3	95	284	22.2	27.5	55	66.6	207	1243
T_{13}	77.7	82	574	44.4	244	975	55.5	240	1198
Mean	**38.4**	**80.1**	**274.1**	**24.2**	**90.9**	**217.4**	**49.5**	**147.5**	**715.1**

After deficient monsoon, fruiting percentage declined drastically, the mean fruiting was observed in 24.2% trees only in April, 2010. There was no fruiting in T_6 and T_{10} treatments, in 11.1% only in T_5 treatment and 22.2% in eight other treatments. T_{13} again was the best treatment where 44.4% trees yield fruit with 243.7g/tree yield. There were very large variations in fruit yield; it was ranging from 10g/tree in T_8 to 334g/tree in T_4 treatment. Zinc application influenced the fruit yield and per tree yield was high in T_4 (341g), T_7 (334g) and T_{13} (243.7g) followed by 123g in T_3. Yield was negligible in most other treatments. Maximum total fruit yield in April, 2010 was 971.0g in T_{13} (FYM+N+Zn+K+SSP) treatment followed by T_4 (FYM+Zn) 681.0g and T_7 (N+Zn) 670.0 g. Yield in other treatments was ranging from 20.0 to 123.0g.

After above average monsoon (562 mm) year, fruiting tree percentage doubled to 49.5% and ranges from nil in control to 77.8% in T_2 and T_{11} treatments. It was observed that trees with high fruit yield in 2010 either did not yield fruit or their yield was negligible.

The total fruit yield ranges from 1.24 kg (T_{12}- FYM + K_2SO_4 + SSP) to nil in control**.** There were very large variations in per tree fruit yield; it was ranging from 32g per tree in T_3 to 353g per tree in T_8 treatment. Treatments significantly (p=0-00) influenced the fruit yield as there was no fruit setting in control. T_{12} was the best treatment recording maximum overall fruit yield of 1.25 kg (207 g per tree) closely followed by T_{13}- 1.20 kg (240 g per tree) and T_8- 1.10 kg (353g per tree), respectively indicating the positive influence of Potassium on fruit yield in a salty soil. Fruit yield in other treatments ranged from 0. 64 to 1.04 kg.

DISCUSSION AND CONCLUSIONS

Very scanty information is available regarding phenological behavior of *S. persica*. The inflorescence is a 10 cm long panicle that bears very small, greenish to yellowish flowers. The fruit is pink to scarlet, spherical, fleshy, 5-10 mm in diameter. It contains one seed that turns from pink to purple to semi transparent at maturity (Ecocrop 2011, Orwa et al. 2009). In India flowering occur from December and January-June. The first fruit ripen in 3 months from flowering initiation (Janick and Paull 2008). Seedless fruits have been reported (Balasubramanium and Bole 1993). However in our study flowering to fruiting is a long process in which first seedless multi-coloured fruits are formed followed by fruits with seed. A systematic study is required to understand the reproductive biology of this important desert species for salt affected areas.

Besides fertilizer application fruit yield was influenced by rainfall also. After deficient monsoon, the mean fruiting was observed in 24.2% trees only in April,

2010. Zinc application influenced the fruit yield and per tree yield was higher in T_4 (341g), T_7 (334g) and T_{13} (243.7g) compared to other treatments. After above average monsoon (562 mm) mean fruiting tree percentage was 49.5% (nil –T_1 to 77.8% in T_2 and T_{11} treatments) in 2011. T_{12} was the best treatment recording maximum overall fruit yield of 1.25 kg (207 g per tree) closely followed by T_{13}- 1.20 kg (240 g per tree) and T_8 - 1.10 kg (353g per tree), respectively indicating the positive influence of Potassium with Phosphorus in high rainfall year.

Generally, *S. persica* bears multicolored fruits (pink, white , purple and dark red). Few trees with only white colour fruit yielded only white fruits in subsequent three years also. Recently, Tahir et al. (2010) reported a new species of *S. persica* with white fruit as *S. alii* however, their morphological description is different from our species, therefore further careful observations should be recorded.

Results indicate that fertilizer application has enhanced the tree growth of *S. persica* on arid salt affected soil. Maximum height increment was 35.9% in T_{12} (FYM + K + P) and T_9 (FYM + N + P) treatments , crown growth in four (T_{13} (FYM + K + P + N + Zn) T_{12}, T_9, & T_6 (FYM + P) treatments ranging from 40 to 51% and for collar girth also four treatments (T_{12}, $T_{13,}$ T_{11} (FYM + Zn + P) & T_6) recording more than 50% incremental growth contain phosphorus either alone or with other elements. Other studies also supported this fact. Singh (1998) reported that in practices for raising Prosopis plantations in saline soils application of phosphorus and zinc aids growth in saline soils. AbdEl-Hady (2007) reported that N, P and K concentrations and their uptake by barley plants increased by increasing Zn application. Rao et al. (2004) reported that application of Ammonium sulphates with saline water irrigation at the time of fruiting enhanced the oil yield in *S. persica*. Thus it can be concluded that with proper nutrient management growth and yield of tree species may be enhanced on salt affected soils.

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