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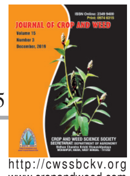

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Influences of intercropping on productivity and profitability of greater yam (*Dioscorea alata* L.)

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ABSTRACT

Greater yam (Dioscorea alata L.) is the widely distributed species of yams, and is an important food crop in tropical regions, cultivated for the consumption of their starchy tubers. The crop is normally planted at a distance of 90 cm x 90 cm and the crop takes about 3-4 months for proper establishment of the canopy after sprouting . Field experiments were conducted at five locations of different agro ecological conditions of India during 2015-16 and 2016-17 to assess the production potential and profitability of different greater yam based intercropping systems, to make use of the spatial and temporal availability of resources during the initial establishment period. Field corn (Zea mays L.), sorghum [Sorghum bicolor (L.) Moench] and pigeon pea [Cajanus cajan (L.) Millsp.] were intercropped with yam in 1:2 ratio at a spacing of 60 × 30 cm and trailing yam vines on intercrops. Pooled data analysis indicated that the maximum yam-equivalent yield (26.05 tha^{-1}), land-equivalent ratio (1.46), net income (3,59,146/-) and B:C ratio (4.12) were obtained with greater yam + maize intercropping in all the locations. Intercropping could result in 31.5% land saving, comparable yam equivalent yields and up to 49% increase in net income compared to sole crop. Hence maize which is a starch rich crop can be profitably inter cropped with greater yam which is another food and nutrition security crop without sacrificing the main crop stand and yield. Maize stalks after harvests of cobs can act as stakes for yam vines also.

Keywords: *Dioscorea alata*, intercropping, maize, pigeon pea, sorghum, tuber yield

Yams are one of the high value root and tuber crops considered as the main source of food in the tropics of the world (O'Sullivan, 2010). Yam is considered as the third most important dietary staple for the low income consumers. These perennial herbaceous crops are cultivated as annuals for their edible starchy tubers, which are a rich source of carbohydrate and energy along with several vitamins and minerals. Of the 600 yam species, only five to six species such as greater yam (*Dioscorea alata* L.), white yam (*D. rotundata* Poir), lesser yam (*D. esculenta* Lour. Burls) and aerial yam (*D. bulbifera* L.) are commercially cultivated. The crop is widely cultivated in South and Central America, Africa, Oceania and Asia and it plays a vital role in food security and improvement of livelihoods (IITA, 2012). Yams also have cultural significance in many parts of the world.

Yams are grown in 61 countries with 97% production in Africa. Nigeria alone contributes 66% of the world production. Five countries *viz.,*Nigeria (47.94 million tons), Ghana (7.95 mt), Cote d'Ivoire (7.15 mt), Benin (3.13 mt) and Ethiopia (1.40 mt) contribute about 93% of the total world production. The productivity of yam ranges from 6.03 tha^{-1} in Fiji to 29.17 t ha^{-1} in Ethiopia with a global average productivity of 8.53 t ha^{-1} (FAO, 2017). Yam is considered to be one of the nutritious crops among the tropical root crops (Wanasundera and Ravindran, 1992; Baah *et al*., 2009). It comprises four times more protein (1.1 to 3.1 g/100g) than cassava, and it is the only main root crop having protein content equivalent to rice (Bradbury and Holloway, 1988).

Yams are generally cultivated throughout India as vegetable crops in homestead or semi commercial scale

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mostly under rainfed conditions. In India, greater yam is cultivated in the states of Andhra Pradesh, Kerala, West Bengal, Bihar, Odisha, North Eastern states, Uttar Pradesh, Tamil Nadu, Gujarat, Maharashtra, Andaman and Nicobar Islands. Based on data provided by All India Coordinated Research Project on Tuber Crops, the gross cultivated area under different yams come to approximately 27000 ha with an average productivity ranging between 15-30 t ha^{-1} in India (AICRP TC, 2016).

The nutritional evaluation of wild yam tubers indicated that the nutritional characters are comparable and almost same to that cultivated yams in different regions of the world excluding for the high value for crude fibre (Bhandari *et al*., 2003). High quantities of carbohydrate and energy with appreciable levels of minerals make the yam nutritious and can be used as reliable food and energy security crop (Kulasinge *et al*., 2018). Normally tubers are consumed as boiled, baked or fried vegetable. It is also useful for making chips, flakes and flour.

The crop is grown at a spacing of 90 cm x 90 cm and takes about 2-4 months for proper establishment of the canopy. Yams are comparatively long duration tuber crops that require 9-10 months to mature. They are vegetatively propagated crops and exclusively propagated by means of small pieces of tuber, during the months of February - April. The crop takes about 6 to 18 days for germination of planted tuber pieces under different agro-climatic conditions of India (AICRP TC, 2016). Once germinated, the vines are elongated within 2-3 months, they are trailed over bamboo/*Casuarina* or wooden poles or nearby standing trees with ropes for proper establishment and to get sunlight for the canopy. In homestead farming, the yam crop can be trailed on different live supports such as trees.

The present investigation was undertaken to assess the production potential and energy-use efficiency of different greater yam based intercropping systems during the initial establishment stages by utilizing the spatial and temporal resources, to explore the alternate possibility of trailing vines, and also for getting supplementary income to poor farmers.

MATERIALS AND METHODS

Field experiments were conducted for two seasons, during 2015-16 and 2016-17 under All India Coordinated Research Project on Tuber Crops at five different locations under five agro climatic zones of India in the states of Chhattisgarh [L_1- Jagdalpur (JGPR)], Andhra Pradesh [L_2- Kovvur (KVR)], Tamil Nadu [L_3- Coimbatore (CBE)], Gujarat [L_4- Navsari (NVSR)] and Maharashtra [L_5- Dapoli (DPL)]. The locations received a total annual rainfall of 827 to 921 mm during the first season and 781 to 855 mm during the second season (Figure 1). Soil type varied among the locations with pH ranging from 5.5 to 8.5 (Table 1). Greater yam was planted at a spacing of 90 x 90 cm apart. Pigeon pea (*Cajanus cajan* L Millsp.), Maize (*Zea mays* L.) and Jowar (*Sorghum bicolor* L. Moench), were planted as intercrops in between greater yam rows in 1:2 ratio, at a spacing of 60 x 30 cm. In all the combinations, yam vines were trailed on the respective intercrops. Greater yam with normal trailing on bamboo/ *Casuarina* poles and a non trailed crop were also raised for comparison of tuber yield. All the intercrops were raised as sole crops also to work out efficiency of the inter cropping. Improved varieties such as Sree Karthika of greater yam (8-9 months), Navjot of maize (3 months), S9 of sorghum (4 months) and Rajeev Lochan of pigeon pea were used for the study.

The following treatments were assessed with three replications in Randomized Block Design (RBD) at each location. The crops were planted as per the treatments.

T_1: Greater yam sole crop (90cm x 90 cm) non-staking (GY NS)

T_2: Greater yam sole crop (90cm x 90 cm) with staking on poles (GY S)

T_3: Greater yam + Pigeon pea (1:2) additive (GY+ PP)

T_4: Greater yam + Maize (1:2) additive (GY + MZ)

T_5: Greater yam + Sorghum (1:2) additive (GY+ JW)

T_6: Pigeon pea sole crop (60 cm x 30 cm) (PP)

T_7: Maize sole crop (60 cm x 30 cm) (MZ)

T_8: Jowar sole crop (60 cm x 30 cm) (JW)

The main crop was harvested after 8-10 months at different locations and tuber yield was recorded in kg from the net plot leaving border rows from each treatment. Then tuber yield per ha was estimated in t ha^{-1}. The intercrops were harvested as per duration of the respective crops . The efficiency of the intercropping systems was assessed in terms of individual crop yield, crop equivalent yield, and the economics.

Land equivalent ratio (LER) : (LER (greater yam) + LER(inter crop) (Mead and Willey, 1980).

$$\text{LER} = \frac{\text{Yield of 'a' as intercrop}}{\text{Yield of 'a' as sole crop}} + \frac{\text{Yield of 'b' as intercrop}}{\text{Yield of 'b' as sole crop}}$$

Crop equivalent Yield (CEY) **:** Crop equivalent yield of main crop was calculated on the basis of prevailing market prices of both the main crop and intercrop.

Equivalent yield of MC = YMC + Y IC (P1/P2) where YMC and YIC are the yields of main crop and intercrop in intercropping system.

P1 and P2 are the selling price of main crop and intercrop

Percentage land saved : As described by Willey (1985) it was calculated using the formula:

% Land saved = 100 – 1/LER x 100.

Economics was also calculated based on the input and output costs of different systems existing in different locations and the B:C ratio was assessed.

$$\text{B : C ratio} = \frac{\text{Gross income from different crop combinations}}{\text{Cost of cultivation}}$$

The data collected over two years from five locations were pooled for statistical analysis. Analysis of Variance was performed using the SAS (2010) / STAT statistical analysis package (version 6.12 , SAS Institute, Cary, NC,USA). The statistical model included sources of variation due to replication, year, location, treatment year x location, year x treatment, location x treatment, location x treatment and year x location x treatment. Means were tested by least significant difference at $P \leq 0.05$.

RESULTS AND DISCUSSION

The performance of the intercropping system was compared in terms of yield of main and intercrops, crop equivalent yield, land equivalent ratio, percentage land saved and the economics.

The tuber yield of greater yam did not vary significantly over the years. However, there was significant difference in tuber yield across the locations (Table 2). The tuber yield ranged from 6.8 t ha^{-1} at Navsari (Gujarat) to 43.8 t ha^{-1} at Kovvur, Andhra Pradesh and Coimbatore (Tamil Nadu)), based on pooled means (Table 3). The greater yam yield was comparatively poor at Jagdalpur, Dapoli, and Navsari. Among the intercrop combinations, greater yam while intercropped with maize resulted in comparable tuber yield with sole crop in all the locations except, Dapoli. At Dapoli, greater yam intercropped with pigeon pea recorded more yam tuber yield 8.13 t ha^{-1}),but the yield data was on par with yam tuber yield from other intercrops combinations. In all the locations, greater yam with staking or trailing the vines on poles recorded the maximum tuber yield (27.42 t ha^{-1}) than the un-staked crop(17.3 t ha^{-1}). Yam is a climber, the vines of which can grow to any length profusely producing leaves to the extent of thousands under favourable conditions. Greater yam usually produces only one or two main shoots. Sometimes due to disturbance to canopy growth, it produces more number of main shoots (Roy, 1998). Continuous production of main shoot has been reported in different yam species (Roy *et al*., 2000). Staking or proper trailing of vines exposes the leaves to sunlight resulting in greater photosynthesis, reducing the competition for sun light. Staking yam vines on bamboo poles resulted in 15 to 100% increase in yield in greater yam in the present study at different locations. Un-staked greater yam resulted in a yield reduction of 53.8% over the staked crop when the mean performance was compared across the locations. This shows the need for staking the vines properly to expose the canopy to sunlight to enhance photosynthesis and proper source-sink balance. However, in some districts of Odisha and Andhra Pradesh, greater yam is cultivated on commercial scale without staking because of the higher cost of cultivation involved as the operation is labour intensive (Nedunchezhiyan *et al*., 2006; Sethuraman *et al*., 2009; Misra and Nedunchezhiyan, 2013). In Africa, yield reduction to the tune of 32% is reported under non staking conditions (Ennin *et al*., 2014). A significantly high yield reduction (43-52%) in greater yam due to nonstaking is reported by Otoo *et al*. (2008).

During the first and the second season, there was significant difference in greater yam tuber equivalent yields under different treatments, locations and the interaction effects of location and treatments (Table 4). Among the five locations, crop performance in terms of yam equivalent yield with intercropping was the best at Coimbatore (36.85 t ha^{-1}) followed by Kovvur (35.06 t ha^{-1}). Yam equivalent tuber yield in T_4 greater yam+ maize combination recorded the maximum value in all the locations (26.05 t ha^{-1}).

Performance of intercrops in terms of tuber equivalent yield was the best for intercropping with maize followed by intercropping with sorghum and pigeon pea. The cob yield of maize was recorded in the range of 4.28 t ha^{-1} at Kovvur to 6.96 t ha^{-1} at Jagdalpur. Grain yield of pigeon pea ranged from 0.31 to 0.97 t ha^{-1} and grain yield of jowar (sorghum) ranged from 1.47 to 3.51 t ha^{-1} at different locations. (Fig. 2). Among the intercrops, maize was found to be the most ideal one which caused the minimum effect on greater yam tuber yield (23.2%), followed by sorghum (33.3 %) and pigeon pea (36.6 %). In Nigeria, intercropping yam with maize led to significant fresh and dry tuber yield reductions across plant densities based on studies conducted (Rebecca *et al*., 2017). They have reported that strong competitive effect of the maize due to the faster growth and earlier nutrient uptake are the reason for this. Similar yam tuber yield reductions when intercropped with maize were reported by Odurukwe (1986) from south east Nigeria. The general reduction in greater yam yields in intercropping , shows that intercrops compete in the early stages with significant effects on yam tuber yield across

Table 1: Soil nutrient status of experimental locations

Location	Soil type	pH	Available N	Available P	Available K
Jagdalpur, Chhattisgarh	Silty clay	6-6.5	medium	medium	medium
Kovvur, Andhra Pradesh	Sandy loam	7.5-8	low	medium	high
Coimbatore, Tamil Nadu	Red loam	8-8.5	medium	high	high
Navsari, Gujarat	Heavy black	7.5-8	low	medium	medium
Dapoli, Maharashtra	Laterite soil	5.5-6	medium	medium	high

Notes: Available N: Low <280 kg/ha; Medium 280-560 kg/ha; High > 560 kg/ha; Available P: Low <10 kg/ha; Medium 10-24.6 kg/ha; High > 24.6 kg/ha; Available K: Low <108 kg/ha; Medium 108-280 kg/ha; High > 280 kg/ ha (Soil testing in India: Methods Manual, 2011)

Table 2: Analysis of variance of F-values of greater yam tuber yield among/between years, locations and treatments

Source	df	F Value	Pr > F
Year (Y)	1	9.85	NS
Location (L)	4	870.69	**
Y × L	4	85.19	**
Treatment (T)	4	95.31	**
Y × T	4	3.66	NS
L × T	16	13.84	**
Y × L × T	16	3.65	**

*NS: not significant; **: significant at P≤0.01*

Table 3: Year x Location × Treatment interaction effects on greater yam tuber yield

Locations	JGPR	KVR	CBE	NVSR	DPL	Mean
Treatments						
T_1: GY NS	15.8gh	21.59f	30.6de	6.8l	11.68ij	17.3c
T_2: GY S	19.5f	43.90a	43.84a	16.35g	13.5hi	27.42a
T_3: GY+ PP	9.01jkl	28.35e	32.57cd	7.24l	8.13kl	17.06c
T_4: GY+ MZ	10.25jk	38.179b	38.178b	8.23kl	7.59kl	20.49b
T_5: GY+ JW	8.24kl	31.11de	34.75c	8.12kl	7.14l	17.87c
Mean	12.56c	32.63b	35.99 a	9.35d	9.61d	

[a] Grouping with same letter denotes no significant difference among the values., P≤0.05

JGPR = Jagdalpur, Chhattisgarh; KVR = Kovvur, Andhra Pradesh; CBE = Coimbatore, Tamil Nadu;NVSR = Navsari, Gujarat; DPL = Dapoli, Maharashtra

Table 4: Analysis of variance of F-values of yam equivalent yields among/between years, locations and treatments

Source	df	F Value	Pr > F
Year (Y)	1	8.72	NS
Location (L)	4	904.69	**
Y × L	4	89.96	**
Treatment (T)	4	118.69	**
Y × T	4	3.78	NS
L × T	16	14.58	**
Y × L × T	16	4.23	**

NS: not significant; **: significant at P≤0.01

Table 5: Year x Location × Treatment interaction effects on greater yam equivalent yield

Locations	JGPR	KVR	CBE	NVSR	DPL	Mean
Treatments						
T_1: GY NS	15.8033[hi]	21.5953[g]	30.6034[ef]	6.8033[n]	11.6850[jkl]	17.2981[d]
T_2: GY S	19.5000[g]	43.9022[a]	43.8432[a]	16.3467[h]	13.5050[ij]	27.4194[a]
T_3: GY+ PP	9.26831[mn]	30.2292[f]	34.2850[cd]	9.0067[mn]	10.3800[klm]	18.6338[c]
T_4: GY+ MZ	21.8700[g]	41.9924[ab]	39.7950[b]	12.7983[jk]	13.8150[hij]	26.054[b]
T_5: GY+ JW	9.87671[m]	32.9832[de]	36.5083[c]	9.52831[m]	8.8200[mn]	19.5433[c]
Mean	**15.2637c**	**34.1405b**	**37.0070a**	**10.8967d**	**11.6410d**	

[a]Values followed by the same letter are not significantly different, P≤0.05
JGPR = Jagdalpur, Chhattisgarh; KVR = Kovvur, Andhra Pradesh; CBE = Coimbatore, Tamil Nadu; NVSR = Navsari, Gujarat; DPL = Dapoli, Maharashtra

the locations. The yams were able to compensate for the phase with competition, especially intercropping with pigeon pea, which was harvested after seven months. The intercrops also suffered a yield reduction to the tune of 25.5 % in sorghum, 29.8 % in maize and 36.7 % in pigeon pea over the respective sole crop across the locations. Among the intercrops, maize and sorghum were of shorter duration (3 and 4 months) compared to pigeon pea in the present study. In India, yams are planted during the months of February- March and the tubers germinate with pre monsoon showers and vines establish with south west monsoon showers during May- June. Thus yam takes 3-4 weeks for sprouting and further 2-3 months for vine establishment of vines. Here all the inter crops were used for staking vines once the crop was established. By then maize followed by sorghum come almost to the maturity stage and were harvested within 3-4 months. The standing stalks were used as standards for staking yam vines. Initial germination and early establishment of intercrops must have resulted in the slow growth of yam vines. Wider spacing of yam accommodating only 2 rows of intercrops could utilize the resources more effectively by intercrops. Hence both the crops could utilize the spatial and temporal resources suitably during initial months and resulted in less yield reduction of maize and sorghum in the present study. For pigeon pea which stands almost for the same duration of yams (seven months), have to compete for sunlight especially with trailing of yam vines which resulted in the poor performance of greater yam+ pigeon poea in combination. When no staking was done, vines were trailing on the ground and the leaves were horizontally oriented in 1-3 overlapping layers. In a study carried out in Gujarat, live staking with elephant foot yam had positive effects on growth, yield and economics of greater yam (Saravaiya *et al*., 2013). The tuber equivalent yield and production efficiency of tuber were significantly affected by intercropping systems. Light interception of the foliage was the major constraint as reported by Rodriguez *et al*. (2001), the efficiency of interception of solar radiation depends on the crop canopy.

Location x treatments interaction showed that there was significant variation in crop equivalent yields. The treatment T_2 at Kovvur recorded the highest yield closely followed by T_2 at Coimbatore T_2 was also on par with the treatment T_4 at Kovvur and Coimbatore. The treatments T_5 and T_3 at Jagdalpur, Dapoli and Navsari were comparatively poorer in yam equivalent tuber yields (Table 4 and5).

The values of land equivalent ratios were more than one in all the crop combinations, which indicates that all the intercrop combinations are advantageous compared to sole crop greater yam. Maximum mean LER was noted for the combination of greater yam + maize across all the locations (1.46). This indicates that 46% (0.46 ha) more area would be required by a sole cropping system to equal the yield of intercropping system. This was followed by greater yam + sorghum intercropping (1.31). Lowest LER was for greater yam + pigeon pea intercropping which recorded a value of 1.20. Maximum LER was recorded at Coimbatore, for yam in combination with maize. Effect of maize intercropping was pronounced with a high LER at Jagdalpur and Kovvur also. At Dapoli and Navsari LER values were more or less same for all the intercrops (Figure 3). However, at Navsari greater yam +maize recorded the highest LER (1.12). However, at Navsari, greater yam +maize recorded the highest LER (1.12) and at Dapoli, Greater yam +sorghum recorded the highest value (1.22). LER shows the efficiency of intercropping systems, for using the environmetal resources as compared to monocropping (Mead and Willey, 1980). When the LER is greater than 1 the intercropping favors the growth and yield of the crops in combination.In contrast, when LER is lower than 1 the intercropping negatively affects the growth and yield of the crops grown in combination (Ofori and Stern, 1987; Cabellero *et al*., 1995).

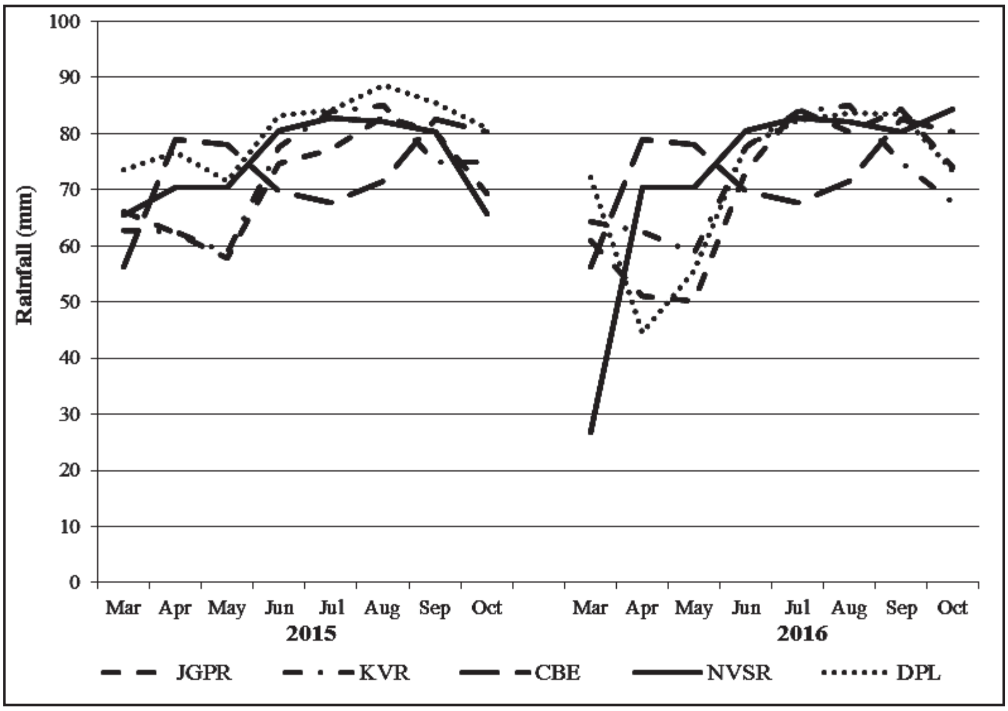

Fig. 1 : Rainfall availability at different locations during crop growing seasons

JGPR = Jagdalpur, Chhattisgarh; KVR = Kovvur, Andhra Pradesh; CBE = Coimbatore, Tamil Nadu; NVSR = Navsari, Gujarat; DPL = Dapoli, Maharashtra

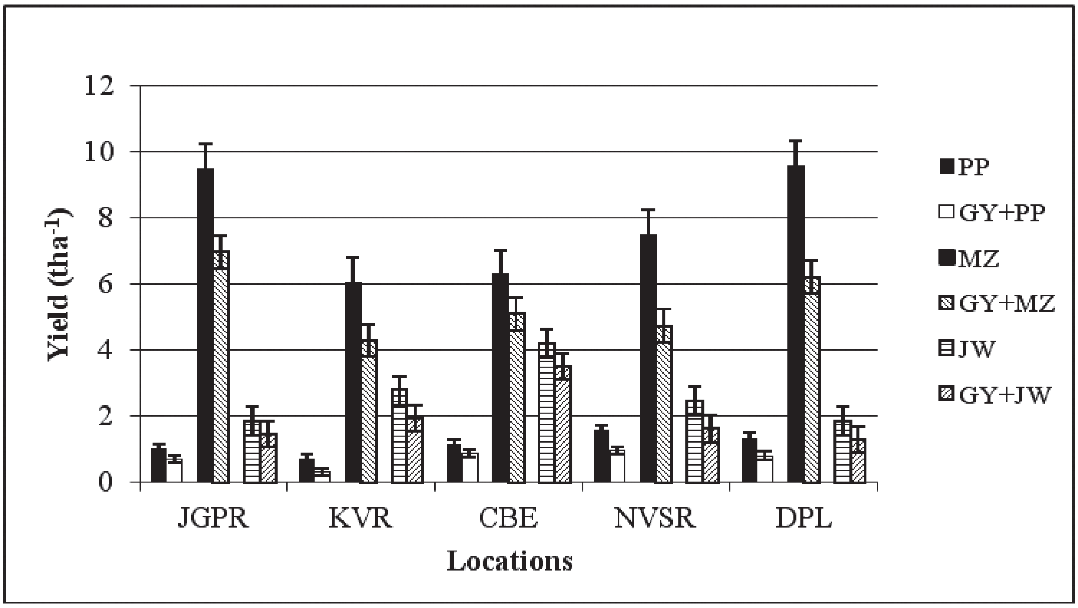

Fig. 2: Yield of intercrops under different treatments and locations

*Bars shown in the graph are standard error

JGPR = Jagdalpur, Chhattisgarh; KVR = Kovvur, Andhra Pradesh; CBE = Coimbatore, Tamil Nadu; NVSR = Navsari, Gujarat; DPL = Dapoli, Maharashtra. PP = Pegion pea; GY + PP = Greater yam + Pegion pea; MZ = Maize; GY + MZ- Greater yam + Maize; JW = Sorghum; GY + JW = Greater yam + Sorghum.

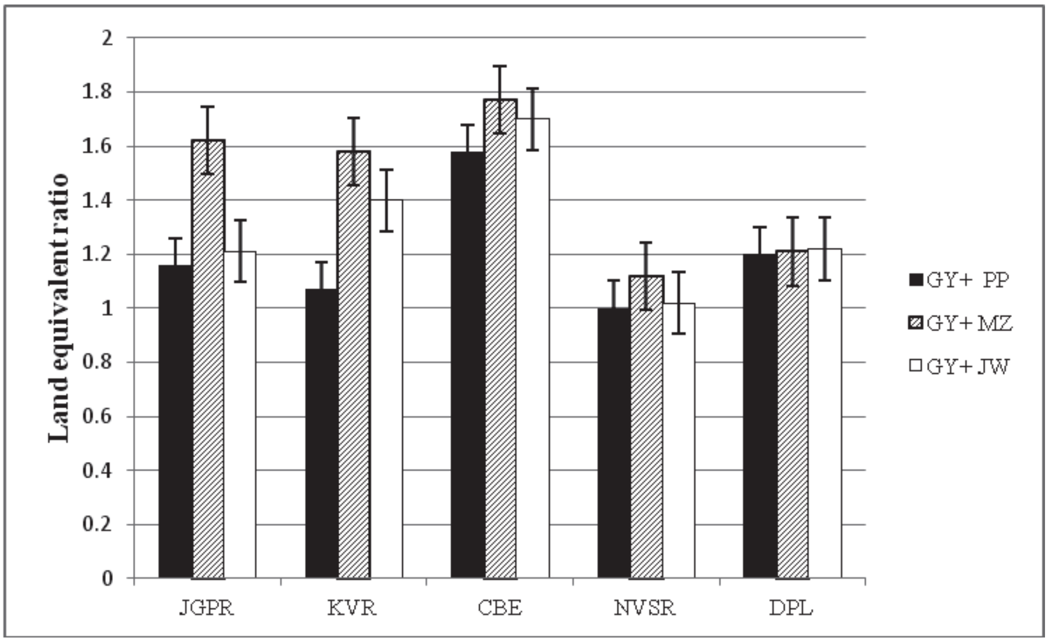

Fig. 3 : Land equivalent ratio of inter crop combinations at different locations

*Bars shown in the graph are standard error
GY + PP = Greater yam + Pegion pea; GY = MZ- Greater yam + Maize; GY + JW = Greater yam + Sorghum. JGPR = Jagdalpur, Chhattisgarh; KVR = Kovvur, Andhra Pradesh; CBE = Coimbatore, Tamil Nadu; NVSR = Navsari, Gujarat; DPL = Dapoli, Maharashtra.

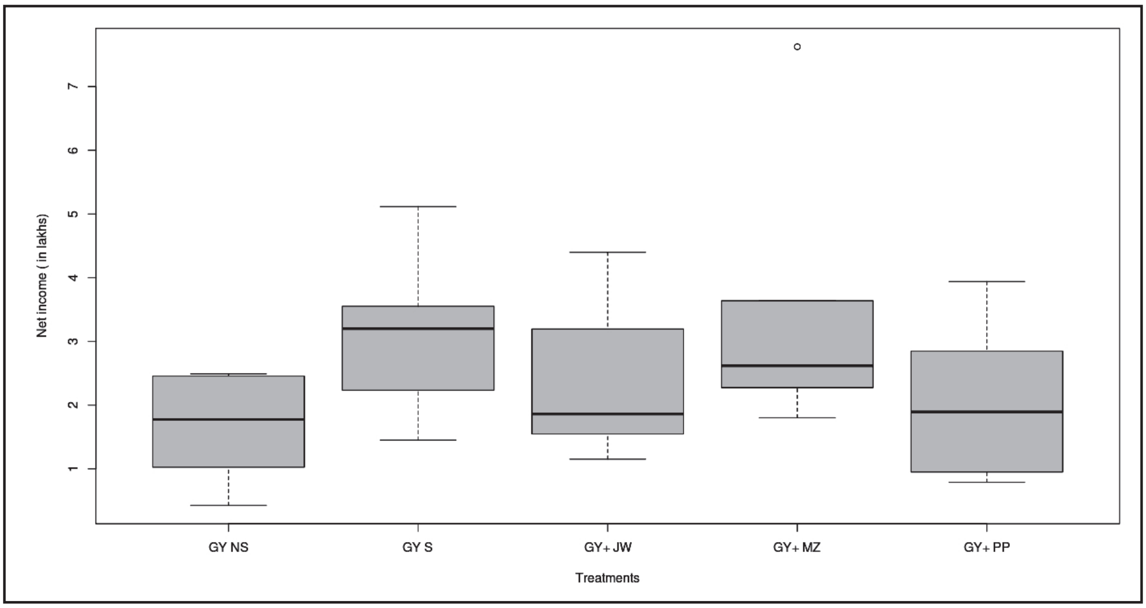

Fig. 4: Distribution of net income (in ₹) among/between treatments and locations

(It is box plot showing the distribution values under different treatments, the central black line shows the median, upper and lower are the maximum and minimum values)
GYNS = Greater yam non-staking; Greater yam staking; GY + JW = Greater yam + Sorghum; GY + MZ = Greater yam + Maize; GY + PP = Greater yam + Pigeon pea.

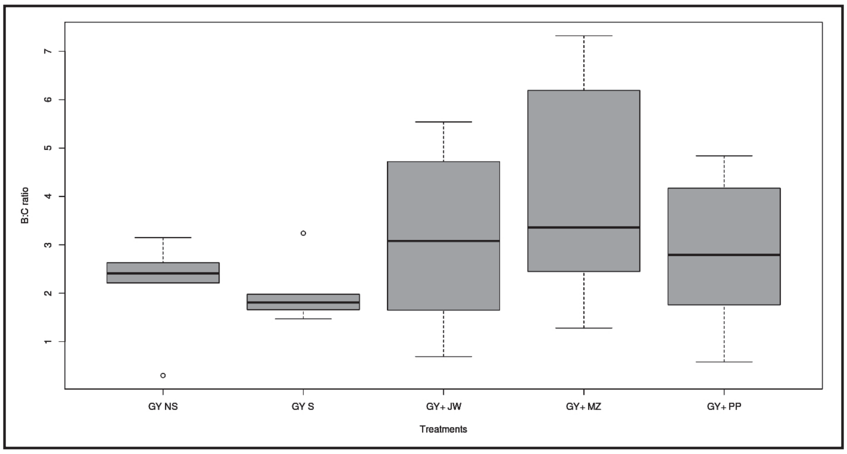

Fig. 5 : Distribution of Benefit:Cost ratio among/between treatments and locations

GYNS = Greater yam non-staking; Greater yam staking; GY+JW = Greater yam+ Sorghum; GY+MZ = Greater yam + Maize; GY+PP = Greater yam + Pigeon pea.

Partial LER values of greater yam was more than 0.5 in intercropping indicating that there was an advantage for greater yam intercropping over all the locations. Among the intercrops, all the crops were in favour of intercropping, except pigeon pea at Kovvur (0.42) which indicated that there was more than 50% reduction in yield with pigeon pea intercropping compared to sole crop. Maximum partial LER was recorded by maize across the locations indicating its complementary effects in intercropping systems. Partial LER values also showed that, compared to sorghum and pigeon pea, maize appears to have more beneficial land use efficiency in all locations.

Although, intercropping reduced the yield of component crops, the land equivalent ratio (LER) was greater than that of sole cropping. Total LER was significantly different ($P < 0.01$) among the crop combinations and values higher than one shows the advantage of intercropping over sole stands. The total LER values were higher than one showing the advantage of intercropping over sole cropping in regard to the use of environmental resources for plant growth. Similar results were reported for mix-proportions of pea-barley (Chen *et al.*, 2004) and in bean-wheat (Hauggaard-Nielsen *et al.,* 2001). Percentage land saving indicated that 31.5% of land could be saved with greater yam + maize intercropping to realise the similar yields when they are grown as sole crops. For greater yam + sorghum intercropping,23.7% and for greater yam + pigeon pea intercropping, 16.8% land was saved due to intercropping than their respective sole crops. The values also indicate the advantages of greater yam + maize combination.

The net income was the highest for intercropping of greater yam with maize in all the locations except Navsari, where greater yam sole crop with staking (T_2) recorded the highest net income. Other intercrops *i.e* T_3 and T_5 failed to record more net income compared to T_2, the sole crop. However, intercropping with all the crops resulted in more net income than the sole crop greater yam grown without staking (T_1). The net income ranged from ₹ 78900 to 393897 for pigeon pea, ₹ 180100 to 762517 for maize and ₹ 154700 to 439890 for sorghum in different locations (Fig. 4).

Benefit: cost ratio also followed a similar trend as net income. In all the locations, high more B:C ratio was recorded with yam and maize combinations, except Navsari. At Navsari, sole crop of greater yam (T_2) resulted in high B:C ratio (1.81). Among the intercrops, greater yam + maize intercropping performed better in terms of B:C ratio, followed by greater yam + sorghum and then, greater yam + pigeon pea. Greater yam without staking recorded more B:C ratio in most of the locations compared to that grown with staking. At Navsari and Coimbatore, greater yam with staking resulted in high B:C ratio. The B:C ratio ranged from 0.58 to 4.84 in greater yam +pigeon pea intercropping, 1.28 to 7.32 in greater yam + maize and 0.69 to 5.54 in greater yam +sorghum in different locations (Fig. 5).

Maize is one of the major food crops contributing to rural and regional sectors in developing countries. Maize as a starch rich crop can be intercropped with greater yam which is another food and nutrition security crop without sacrificing the main crop stand and tuber equivalent yield. Maize stalks after cob harvests can be used as stakes for trailing of yam vines. The present study clearly reveals that greater yam intercropped with maize in 1: 2 additive series is a profitable system in most of the locations of humid tropical zones of India.

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