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Nutrient Uptake under Inter-Cropping Systems of Ginger and Cowpea and Weed Management Practices

A. Baruah[1*] and J. Deka[2]

[1]Dow Agro Sciences India Pvt. Ltd., Kolkata-700157, West Bengal, India
[2]Assam Agricultural University, Jorhat-785013, Assam, India

**Corresponding author*

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A B S T R A C T

A field experiment was conducted in Assam Agricultural University, Jorhat district, Assam, India to understand the effectiveness of inter-cropping system and chemical weed management on nutrient uptake by ginger (*Zingiber officinale* Rosc.), inter-crop and weeds, during 2013-14 and 2014-15. There were 16 numbers of treatment combinations, comprising of 4 inter-cropping systems and 4 weed management practices. Intercropping of Cowpea in between rows of Ginger and incorporated at 40 days after sowing (DAS) and treatment with Metribuzin 500 g ai ha^{-1} + hand weeding (HW) at 70, 100 and 140 days after planting (DAP) recorded better results in terms of crop yield and nutrient uptake by ginger and cowpea. On the contrary, weedy check recorded the highest nutrition uptake by weeds at almost all the considered time intervals. At the time of ginger harvest, treatments Ginger + Cowpea (2:1) and Cowpea incorporated at 40 DAS and Hand weeding (HW) at 40, 70, 100 and 140 DAP recorded better results in terms of P_2O_5 and K_2O availability in soil.

Introduction

In India, Ginger (*Zingiber officinale* Rosc.) is considered to be a high valued commercial crop due to its multipurpose uses. Also, India is one of the major producer and consumer of ginger, accounting for about 30-40% of the global share of production, followed by China, Nepal and Indonesia (Gracy *et al.*, 2013). But ginger is an exhaustive crop, therefore nutrient availability and uptake is critical for its production. Due to wider spacing, it faces severe competition for nutrition from weeds. Growing of intercrops and application of pre-emergence herbicide can be an effective approach towards better nutrient uptake by ginger, its enhanced growth and yield due to effective weed management. The current study was undertaken with the intent to understand the impact of inter-crops and chemical weed management on nutrient uptake by crops and weeds and yield of ginger.

Materials and Methods

Soils characteristics

Prior to initiating the experiment, representative soil samples were collected randomly and analysed for their chemical

properties. The texture of the soil was found to be sandy loam with acidic in reaction. For both the years i.e. 2013-14 and 2014-15, available Nitrogen (N) and Potassium (K_2O) were in medium range whereas Phosphorus (P_2O_5) was low. A detail description of chemical properties of the soil and methods used are presented in Table 1.

Treatment details

There were 16 treatment combinations comprising of 4 Cropping Systems *viz.*, I_1: Ginger + Cowpea (2:1); Cowpea incorporated at 40 DAS, I_2: Ginger + Cowpea (3:1); Cowpea incorporated at 40 DAS, I_3: Cowpea in between rows of Ginger and incorporated at 40 DAS, I_4: Cowpea in between alternate rows of Ginger and incorporated at 40 DAS and 4 Weed Management Practices *viz.*, W_1: Weedy (Control), W_2: Hand weeding at 40, 70, 100 and 140 DAP, W_3: Pre-emergence application of Oxadiargyl 90 g ai ha^{-1} + hand weeding at 70, 100 and 140 DAP and W_4: Pre-emergence application of Metribuzin 500 g ai ha^{-1} + hand weeding at 70, 100 and 140 DAP.

Planting/sowing and inter-cultural operations

The ginger variety 'Nadia' pre-treated with Mancozeb were planted in a spacing of 60 cm between two rows and 25 cm between rhizomes. The number of ginger rows was as per the row ratios in the cropping system treatments. A short duration fodder variety of cowpea 'UPC-278' was sown as an inter-crop as per the treatment requirement. The herbicides, Metribuzin and Oxadiargyl were applied with a spray volume of 500 l ha^{-1} on the 3rd day after planting of ginger rhizomes.

The plots were mulched with rice straw @ 4 t ha^{-1} in two splits, one immediately after planting of ginger and second at 70 DAP. Light earthing up of ginger was done in all the plots at 60 and 100 DAP, except the Weedy plots. Need based plant protection measures were adopted to manage pests and diseases as per package and practices recommended by Assam Agricultural University. In both the years, cowpea was uprooted and incorporated in the soil on the 40th day after sowing and ginger crop was harvested on the 262nd day after planting in both the years.

Results and Discussion

Effect on yield of crops

In 2013-14 and 2014-15, treatment Cowpea in between Ginger and incorporated at 40 DAS recorded significantly higher fresh biomass weight of cowpea whereas weed management with Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP recorded significantly higher fresh biomass weight of cowpea in both the years (Table 2).

Intercropping of Cowpea in between Ginger and incorporated at 40 DAS recorded highest ginger yield of 7542 kg ha^{-1}in 2013-14 and 8633 kg ha^{-1} in 2014-15. It was statistically *at par* with the treatment Cowpea in alternate rows and incorporated at 40 DAS. Application of Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP recorded significantly higher ginger yield of 7817and 9340kg ha^{-1} in 2013-14 and 2014-15, respectively as compared to other weed management treatment (Table 2).

Effect on nutrient uptake by crops

In both the years of experimentation, highest Nitrogen (N) uptake of 98.8 kg ha^{-1} (2013-14) and 114.7 kg ha^{-1} (2014-15) by ginger was recorded in the treatment Cowpea in between Ginger and incorporated at 40 DAS. It was statistically *at par* with the treatment Cowpea in alternate rows and incorporated at 40 DAS. Highest Phosphorus (P) uptake by ginger was

also recorded in the treatment Cowpea in between Ginger and incorporated at 40 DAS, which recorded uptake of 11.5 kg ha^{-1} in 2013-14 and 13.3 kg ha^{-1} in 2014-15, but it was statistically *at par* with the treatment Cowpea in alternate rows and incorporated at 40 DAS. A similar trend was also observed in respect of Potassium (K) uptake by ginger.

Inter-cropping system Cowpea in between Ginger and incorporated at 40 DAS recorded the highest K uptake of 108.5 and 118.4 kg ha^{-1} in 2013-14 and 2014-15, respectively which was *at par* with the treatment Cowpea in alternate rows and incorporated at 40 DAS (Table 3). Thus, in both the years, intercropping treatment Cowpea in between Ginger and incorporated at 40 DAP recorded highest nutrient uptake by ginger. Better biomass production by ginger under this intercropping system due to better weed smothering at the critical stage of competition and N fixation by legume cowpea and its incorporation might have increased the nutrient uptake (Willey, 1979).

Amongst the weed management practices, Metribuzine 500 g ha^{-1} pre-em + HW 70, 100 and 140 DAP recorded significantly higher N uptake of 106.8 kg ha^{-1} in 2013-14 and 128.1 kg ha^{-1} in 2014-15 by ginger. This treatment also recorded significantly higher P uptake of 12.4 and 14.9 kg ha^{-1} in 2013-14 and 2014-15, respectively as compared to other weed management treatments. K uptake of 113.2 and 121.7 kg ha^{-1} in 2013-14 and 2014-15, respectively by ginger was also recorded in Metribuzine 500 g ha^{-1} pre-em + HW 70, 100 and 140 DAP (Table 3), which was significantly higher than other weed management. Nutrient uptake in Metribuzin treated plots were followed by the treatment Oxadiargyl 90 g ha^{-1} pre-em + HW 70, 100 and 140 DAP. Metribuzin application followed by 3 hand weeding created a sustained competition free environment for better growth of ginger finally contributing towards increased nutrient uptake by the crop. Similar, results are reported by Sathiyavani and Prabhakaran (2015) also in turmeric.

Intercropping of Cowpea in between Ginger and incorporated at 40 DAS, recorded significantly higher uptake of N, P and K by cowpea as compared to all other cropping systems (Table 4). This might be due to the closer row spacing which created an ideal weed free condition. It contributed towards better biomass production leading to higher nutrient uptake by cowpea.

Weed management with Metribuzine 500 g ha^{-1} pre-em + HW 70, 100 and 140 DAP recorded significantly higher uptake of N, P and K by cowpea than rest of the weed management treatments (Table 4). It was followed by the treatment Oxadiargyl 90 g ha^{-1} pre-em + HW 70, 100 and 140 DAP. Pre-emergence application of those two herbicides resulted effective weed control during the critical phases, thus helping better nutrient uptake by the inter-crop cowpea.

Table.1 Chemical properties of surface soil at experimental site

Particular(s) (kg ha^{-1})	Value(s)		Method adopted
	2013-14	2014-15	
Available N	388.0	369.40	Kjeldahl Method (Jackson, 1973)
Available P_2O_5	17.8	13.8	Bray-I Method (Jackson, 1973)
Available K_2O	239.4	252.3	Flame Photometric Method (Jacson,1973)

Table.2 Fresh biomass weight of cowpea and rhizome yield of ginger (kg ha^{-1})

Treatment	Cowpea biomass weight (kg ha^{-1})		Ginger rhizome yield (kg ha^{-1})	
	2013-14	2014-15	2013-14	2014-15
Cropping system				
I_1: G*+C* (2:1); C incorp. 40 DAS	4679	4523	5846	6175
I_2: G+C (3:1); C incorp. 40 DAS	3656	3729	5925	6454
I_3: C in between G; incorp. 40 DAS	14333	10158	7542	8633
I_4: C in alternate rows; incorp. 40 DAS	9229	7458	7338	8505
$CD_{P=0.05}$	448	305	419	635
Weed management				
W_1: Weedy	7796	6196	5021	4825
W_2: HW 40, 70, 100 and 140 DAP	7563	6108	6533	7396
W_3: Oxadiargyl 90 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	8043	6606	7279	8208
W_4: Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	8497	6958	7817	9340
$CD_{P=0.05}$	448	305	338	635

G*=Ginger, C* Cowpea, pre-em=Pre-emergence

Table.3 Nutrient (N, P and K) uptake by ginger (kg ha^{-1})

Treatments	N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Cropping system						
I_1: G*+C* (2:1); C incorp. 40 DAS	66.7	71.1	8.2	8.7	72.2	76.7
I_2: G+C (3:1); C incorp. 40 DAS	67.6	74.1	8.3	9.1	73.2	80.0
I_3: C in between G; incorp. 40 DAS	98.8	114.7	11.5	13.3	108.5	118.4
I_4: C in alternate rows; incorp. 40 DAS	96.1	113.0	11.2	13.1	105.6	116.5
$CD_{P=0.05}$	4.3	2.4	0.5	0.3	4.6	4.5
Weed management						
W_1: Weedy	40.1	38.5	5.5	5.3	52.7	50.7
W_2: HW 40, 70, 100 and 140 DAP	83.2	94.4	9.8	11.1	88.7	100.7
W_3: Oxadiargyl 90 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	99.1	111.9	11.5	13.0	105.0	118.5
W_4: Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	106.8	128.1	12.4	14.9	113.2	121.7
$CD_{P=0.05}$	4.3	4.1	0.5	0.3	4.6	4.5

G*=Ginger, C* Cowpea, pre-em=Pre-emergence

Table.4 Nutrient (N, P and K) uptake by cowpea (kg ha^{-1})

Treatments	N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Cropping system						
I_1: G*+C* (2:1); C incorp. 40 DAS	44.0	41.5	6.7	6.4	54.0	52.3
I_2: G+C (3:1); C incorp. 40 DAS	34.3	35.1	5.2	5.3	42.0	43.0
I_3: C in between G; incorp. 40 DAS	160.3	111.2	21.9	15.6	195.0	137.2
I_4: C in alternate rows; incorp. 40 DAS	106.7	82.8	14.1	11.2	127.1	100.2
$CD_{P=0.05}$	4.4	2.6	0.4	0.5	3.9	3.6
Weed management						
W_1: Weedy	79.8	63.0	11.5	9.1	94.4	74.5
W_2: HW 40, 70, 100 and 140 DAP	79.0	62.1	11.1	9.0	91.6	73.5
W_3: Oxadiargyl 90 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	90.1	70.7	12.3	10.1	114.8	91.1
W_4: Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	94.7	74.7	12.9	10.7	119.4	94.8
$CD_{P=0.05}$	4.4	2.6	0.4	0.5	3.9	3.6

G*=Ginger, C* Cowpea, pre-em=Pre-emergence

Table.5 Nitrogen (kg ha^{-1}) uptake by weeds

Treatments	2013-14					2014-15				
	40 DAP	70 DAP	100 DAP	130 DAP	160 DAP	40 DAP	70 DAP	100 DAP	130 DAP	160 DAP
Cropping system										
I_1: G*+C* (2:1); C incorp. 40 DAS	23.2	55.2	72.5	84.5	87.4	20.7	49.7	66.9	78.7	82.9
I_2: G+C (3:1); C incorp. 40 DAS	23.3	47.0	62.0	71.7	75.8	20.9	42.3	57.2	66.8	70.8
I_3: C in between G; incorp. 40 DAS	13.5	28.4	38.6	47.4	50.3	12.1	24.9	37.1	43.6	46.1
I_4: C in alternate rows; incorp. 40 DAS	15.0	31.6	41.8	49.5	52.3	13.6	28.1	36.1	45.6	48.4
$CD_{P=0.05}$	2.0	1.4	2.6	2.2	2.7	1.0	1.4	1.8	2.9	3.4
Weed management										
W_1: Weedy	35.1	103.6	131.3	150.5	155.0	29.1	96.3	123.6	142.6	148.5
W_2: HW 40, 70, 100 and 140 DAP	20.8	21.1	30.1	37.0	39.5	30.0	17.9	26.8	33.6	36.2
W_3: Oxadiargyl 90 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	11.0	19.4	27.5	33.7	36.5	9.9	16.1	24.2	30.5	33.2
W_4: Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	8.0	18.1	26.0	31.8	34.7	6.9	14.8	22.8	27.9	30.4
$CD_{P=0.05}$	2.0	1.4	2.6	2.2	2.7	1.0	1.4	1.8	2.9	3.4

G*=Ginger, C* Cowpea, pre-em=Pre-emergence

Table.6 Phosphorus (kg ha^{-1}) uptake by weeds

Treatments	2013-14					2014-15				
	40 DAP	70 DAP	100 DAP	130 DAP	160 DAP	40 DAP	70 DAP	100 DAP	130 DAP	160 DAP
Cropping system										
I_1: G*+C* (2:1); C incorp. 40 DAS	3.27	7.4	9.8	11.5	12.1	3.0	6.6	9.0	10.7	11.3
I_2: G+C (3:1); C incorp. 40 DAS	3.50	6.4	8.5	9.8	10.4	3.0	5.7	7.7	9.1	9.7
I_3: C in between G; incorp. 40 DAS	2.00	3.8	5.2	6.4	6.8	1.8	3.3	4.8	5.7	6.2
I_4: C in alternate rows; incorp. 40 DAS	2.16	4.1	5.6	6.7	7.0	2.0	3.7	4.8	6.1	6.5
$CD_{P=0.05}$	0.28	0.2	0.5	0.4	0.5	0.2	0.2	0.4	0.4	0.5
Weed management										
W_1: Weedy	4.13	12.2	15.4	17.7	18.4	3.5	11.3	14.4	16.8	17.4
W_2: HW 40, 70, 100 and 140 DAP	3.53	3.6	5.1	6.2	6.8	3.7	3.0	4.5	5.6	6.1
W_3: Oxadiargyl 90 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	1.76	3.1	4.4	5.4	5.8	1.5	2.5	3.9	4.8	5.3
W_4: Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	1.51	2.9	4.0	5.1	5.4	1.4	2.4	3.5	4.5	4.9
$CD_{P=0.05}$	0.28	0.2	0.5	0.4	0.5	0.2	0.2	0.4	0.4	0.5

G*=Ginger, C* Cowpea, pre-em=Pre-emergence

Table.7 Potassium (kg ha^{-1}) uptake by weeds

Treatments	2013-14					2014-15				
	40 DAP	70 DAP	100 DAP	130 DAP	160 DAP	40 DAP	70 DAP	100 DAP	130 DAP	160 DAP
Cropping system										
I_1: G*+C* (2:1); C incorp. 40 DAS	28.8	66.9	87.6	103.2	108.6	25.8	60.3	81.4	96.2	101.6
I_2: G+C (3:1); C incorp. 40 DAS	29.4	55.4	73.6	85.4	89.6	26.2	49.8	67.4	79.3	84.4
I_3: C in between G; incorp. 40 DAS	17.4	34.7	46.6	58.5	61.2	15.6	30.5	45.3	53.7	56.1
I_4: C in alternate rows; incorp. 40 DAS	19.4	37.3	53.4	61.0	63.7	17.6	32.7	43.8	55.4	59.1
$CD_{P=0.05}$	2.5	1.6	3.4	2.8	2.9	1.2	1.5	1.8	3.0	4.3
Weed management										
W_1: Weedy	37.4	110.1	139.7	159.9	164.6	28.9	102.4	131.4	151.6	157.8
W_2: HW 40, 70, 100 and 140 DAP	30.7	31.0	44.3	54.4	58.1	30.1	26.1	39.3	49.4	53.2
W_3: Oxadiargyl 90 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	15.5	27.4	39.8	48.0	51.5	14.0	23.1	34.3	43.3	47.2
W_4: Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	11.3	25.8	37.4	45.9	48.9	9.7	21.7	32.9	40.4	43.1
$CD_{P=0.05}$	2.5	1.6	3.4	2.8	2.9	1.2	1.5	1.8	3.0	4.3

G*=Ginger, C* Cowpea, pre-em=Pre-emergence

Table.8 Available nutrients (kg ha^{-1}) in the soil at the time of cowpea incorporation

Treatments	N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Cropping system						
I_1: G*+C* (2:1); C incorp. 40 DAS	264.2	266.3	35.9	37.2	83.9	91.3
I_2: G+C (3:1); C incorp. 40 DAS	255.5	270.4	29.3	30.7	76.2	82.0
I_3: C in between G; incorp. 40 DAS	280.0	282.2	20.7	22.0	54.1	65.3
I_4: C in alternate rows; incorp. 40 DAS	272.6	276.2	23.3	24.6	64.3	74.3
$CD_{P=0.05}$	NS	NS	3.6	3.7	5.4	3.9
Weed management						
W_1: Weedy	265.0	267.8	26.0	27.4	67.6	76.0
W_2: HW 40, 70, 100 and 140 DAP	270.8	278.7	28.7	30.0	72.4	80.8
W_3: Oxadiargyl 90 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	268.5	276.2	27.8	29.1	69.7	78.6
W_4: Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	267.9	272.5	26.7	28.0	68.7	77.5
$CD_{P=0.05}$	NS	NS	NS	NS	NS	NS

G*=Ginger, C* Cowpea, pre-em=Pre-emergence

Table.9 Available nutrients (kg ha^{-1}) in the soil at the time of ginger incorporation

Treatments	N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Cropping system						
I_1: G*+C* (2:1); C incorp. 40 DAS	269.1	260.3	30.5	31.7	73.2	74.5
I_2: G+C (3:1); C incorp. 40 DAS	264.8	257.1	26.3	27.6	67.0	68.4
I_3: C in between G; incorp. 40 DAS	279.9	274.3	19.6	20.6	50.8	52.2
I_4: C in alternate rows; incorp. 40 DAS	277.9	260.3	21.0	22.9	59.0	60.3
$CD_{P=0.05}$	NS	NS	3.2	2.7	4.7	4.7
Weed management						
W_1: Weedy	266.5	255.4	17.9	19.1	47.3	48.6
W_2: HW 40, 70, 100 and 140 DAP	278.0	266.1	27.3	28.7	69.9	71.2
W_3: Oxadiargyl 90 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	274.5	265.4	26.5	27.9	67.1	68.4
W_4: Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP	272.7	265.2	25.7	27.2	65.8	67.1
$CD_{P=0.05}$	NS	NS	3.2	2.7	4.7	4.7

G*=Ginger, C* Cowpea, pre-em=Pre-emergence

Effect on nutrient uptake by weeds

In both the years of experimentation, highest N uptake by weeds during initial phase (40 DAP) was recorded in the treatment Ginger + Cowpea (3:1) and Cowpea incorporated at 40 DAS, which was *at par* with Ginger + Cowpea (2:1) and Cowpea incorporated at 40 DAS. But at subsequent stages (70, 100, 130 and 160 DAP), significantly higher N uptake was recorded in the treatment Ginger + Cowpea (2:1) and Cowpea incorporated at 40 DAS. On the other hand, the lowest N uptake was by weeds was recorded under Cowpea in between Ginger and incorporated at 40 DAS at all the stages in both the years (Table 5). Highest P and K uptake was recorded at 70, 100, 130 and 160 DAP, respectively in the treatment Ginger + Cowpea (2:1) and Cowpea incorporated at 40 DAS. The treatment Cowpea in between Ginger and incorporated at 40 DAS recorded the lowest P and K uptake by weeds at all the stages of observation in both the years (Table 6 and 7). Increasing intercrop density showed better suppression of weeds resulting lower nutrient uptake by weed.

Application of Metribuzine 500 g ha^{-1} pre-em+ HW 70, 100 and 140 DAP at all the stages in both the years showed the lowest uptake of N, P and K by weeds as compared to the other weed management treatments (Table 5, 6 and 7). The result trend of weed density and weed dry weight resembled the trend of uptake of different nutrients at various stages of growth. This result is in concomitance with the reports of Sathiyavani (2014) in turmeric.

Effect on available nutrients in soil

Intercropping systems had no significant effect on the available N in the soil at the time of cowpea incorporation in both the years. However, Ginger + Cowpea (2:1) and Cowpea incorporated at 40 DAS resulted significantly higher amount of P_2O_5 and K_2O at the time of cowpea incorporation in both the years. Different weed management practices had no effect on the available nutrients in the soil at the time of cowpea incorporation in both the years (Table 8).

Available N in the soil at the time of ginger harvest in both the years of experimentation was not impacted by the intercropping systems. But significantly higher available P_2O_5 and K_2O was recorded in Ginger + Cowpea (2:1) and Cowpea incorporated at 40 DAS in both the years in relation to other cropping systems. Different weed management practices had no significant effect on the available N in the soil at the time of ginger harvest in both the years. Hand weeding at 40, 70, 100 and 140 DAP recorded highest available P_2O_5 in both the years. Similarly, this treatment also recorded highest available K_2O at the time of ginger harvest (Table 9). It might be due to lesser uptake of nutrients by the crop as compared to integrated weed management treatments using pre-emergence herbicides.

References

Gracy, C. P.; Jyoti, N. J. and Nagashree, N. (2013). Ginger price forecast - Store and sell ginger. *Agropedia*.

Palaniappan, S. P. (1988). Cropping system in the tropics. In: *Principles and Management*. Wiley Eastern Limited, New Delhi.

Sathiyavani, E. (2014). Evaluation of integrated weed management with pre and post emergence herbicides in turmeric. Ph.D. Thesis. Directorate of crop management, Tamil Nadu Agricultural University, Coimbatore.

Sathiyavani, E. and Prabhakaran, N. K. (2015). Effect of integrated weed management practices on plant height,

number of tillers in turmeric during *kharif* season. *International Journal of Horticulture* 5(2): 1-8.

Willey, R. W. (1979). A scientific approach to intercropping research. In: *The Proceeding of the International Workshop on Intercropping*. ICRISAT, Hyderabad, 10-13 Jan.

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