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Screening of Cowpea Genotypes for Their Reactions to *Alectra Vogelii* (Benth.) in the Southern Guinea Savanna of Nigeria

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Abstract
Field experiments were conducted at Garkawa, Plateau State, Nigeria (08°52'N; 09°34'E) during the rainy seasons of 2011 and 2012 to evaluate the reactions of cowpea genotypes to *Alectrra* infestations. The treatments consisted of eleven cowpea genotypes laid out in a Randomized Complete Block Design with three replications. Five varieties (IT97K-499-35, IT98K573-1-1, IT03K-338-1, IT98K-205-8 and UAM 11D, 24-55-3) were confirmed resistant to *Alectra* in the study area. The Gazum local variety, Banjar, Borno brown, and TVX3236 were found to be very susceptible to *Alectra*; while IT84S-246-4 and IT98KD-391 recorded moderate infestation of *Alectra*. The combined year effect on days to *Alectra* emergence showed that Gazum local, TVX3236, Banjar and Borno brown supported significantly the earliest emergence of *Alectra*; while the genotypes IT89KD-373-1-1 and IT84S-246-4 delayed the emergence of *Alectra* by 6 and 4 days , respectively. Gazum local recorded the highest number of crop plants infested with *Alectra.* Similarly, *Alectra* shoot counts were highest in Gazum local and TVX 3236. Apart from IT84S-246-4 in 2011, pod number, pod weight and 1000 seed weights were significantly higher in the *Alectra* free genotypes against lower values in the *Alectra* infested genotypes. Also, the *Alectra* infested genotypes recorded significantly more crop damaged syndrome score compared with the resistant genotypes which were healthier. It may be concluded from this investigation that IT97K-499-35, IT98K-573-1-1, IT03K-338-1, IT98K-205-8 and UAM 11D-24-55-3 that were found to be resistant to *Alectra* infestation which gave relatively higher grain yields are recommended for cultivation by farmers in the study area.
Keywords: key words, Cowpea genotypes, *Alectra vogelii*, Resistance/ Tolerance, Guinea Savannah.

1. Introduction

Cowpea, *Vigna unguiculata* (L) Walp is one of the most important and widely grown legumes in the savanna and sahel regions of Africa (Steele, 1976). It plays a critical role in the lives of millions of people in Africa and other parts of the developing world where it is a major source of dietary protein that nutritionally compliments staple low protein cereal and tuber crops. It is also a valuable and dependable commodity that provides income for farmers and traders (Singh, 2002; Longyintou *et al*, 2003). Another important feature of cowpea is that it fixes atmospheric nitrogen through symbiosis with nodule bacteria (*Bradyrhizobium* spp), thereby increasing N levels in the soil for the benefit of the following cereal crop grown in a rotation. Similarly, the above ground parts of cowpea, excepting pods, are usually harvested as fodder for Livestock feed (Bressani, 1985).

Alectra vogelii (Benth.), is a hemiparasite parasitic plant belonging to the family Scrophulariaceae and is a parasitic plant of a wide range of legumes in the West, East and South Africa (Bagnall-Oakeley *et al.,* 1991). Aggarwal (1985) and Emechebe *et al.* (1991) have observed that *Alectra* appears to be more destructive in the Northern Guinea and Sudan agro-ecologies, because of the marginal nutrient status of the soils and unreliable rainfall in these zones. *Alectra* and related parasitic weeds including *Striga* are presently among the most important biological constraints to food production in Africa. Although crop attack by *Alectra* has less severe impact than that of *Striga*, total yield loss is not uncommon in fields that are heavily infested by these parasites when susceptible varieties are planted (Emechebe *et al*., 1983). Significant crop yield losses caused by *Alectra* have been reported in legumes including cowpea, broad and velvet beans, groundnuts, bambara groundnut and grams (Riches, 1987; Lagoke *et al.,* 1988). Several cultivated lands have been abandoned due to high infestations with the noxious parasitic weeds (Lagoke *et al*., 1988). Fields infested by these parasitic weeds are difficult to clean, because of the considerable amount of seeds produced and the dormancy mechanisms, which enable them to survive in the soil for several years (Emechebe *et al*., 1983). *Alctra vogelii* has been reported to be the cause of considerable damage to cowpea, with substantial yield reductions especially in Africa (Emechbe *et a*l, 1991; Lagoke *et a*l, 1994). Yield losses associated with *Alectra vogelii* have been reported to range from between 83 and 100% (Cardwell and Lane, 1991, Singh *et al*, 1993). Although considerable work has been done on various control methods for parasitic weeds, *Alectra* control in cowpea has received relatively little attention. It is however apparent that no single method can adequately control this problem and a number of methods would need to be integrated for effective control. Dugje *et al*, 2006, carried out a survey of the level of *Alectra vogelii* infestation on farmers' field in North Eastern Nigeria and reported that more than 81% of the fields grown to cowpea in this region were infested with *Alectra vogelii* resulting in serious yield losses.

The control of *Alectra vogelii* is difficult mainly because of the unique adaptation of the parasite to its environment and the complexity of the host-parasite relationship (Botanga and Timko, 2005). General control measures for *Alectra* species include trap crops, hand pulling, cultivation of resistant cultivars and application of herbicides (Ogborn, 1987; Parkinson *et al,* 1997, Sand *et al*, 1990; Magani and Lagoke, 2009). Among these control measures, no one method has been found to be effective for the control of parasitic weeds. However the use of resistant cultivars seemed to be a more viable option. This study was therefore carried out to assess the reaction of eleven cowpea genotypes to *Alectra vogel*ii infestations with a view of identifying resistant varieties that could be recommended to farmers for optimum cowpea production in the study area.

2. Materials and Methods

Field trials were conducted in 2011 and 2012 at the Teaching and Research Farm of the Department of Agricultural Technology, Plateau State College of Agriculture Garkawa (08°52'N; 09°24'E) in the Southern Guinea Savanna where sandy loam is the dominant soil type. The site used for the trials was naturally and heavily infested with *Alectra*.The land was ploughed, harrowed and ridged at 0.75m apart. Ten cowpea genotypes were obtained from UAM cowpea breeding programme funded by Kirkhouse Trust. One local genotype (Land race) known to be susceptible to *Alectra vogelii* (Gazum local) was used as a check.

Three cowpea seeds were planted per hole on 28th of August and 26th August 2011 and 2012, respectively. Thinning was done at two weeks after planting (WAP) to give two plants per stand. Weed control was done manually at 3 and 4 WAP. Thereafter hand pulling was employed to avoid damage to the *Alectra* plants. Fertilizer was applied by band method at 2 WAP at the rate of 100kg ha^{-1} of NPK (15:15:15) compound fertilizer to give the equivalent of 15kg a.i. ha^{-1} N, P_2O_5 and K_2O, respectively. Insects were controlled with chemical insecticides by spraying at 5% flower initiation and at 2 weeks intervals thereafter with BEST Action Cypermethrin plus Dimethoate at the rate of 1.5 litres/ha, using a Knapsack sprayer. The experiments were laid out in a Randomized Complete Block Design with three replications. Each plot consisted of four rows, 4m long at spacing of 0.20m intra-row and 0.75m inter row.

3. Results and Discussion

Reactions of cowpea genotypes to *Alectra* parameters viz; days to *Alectra* emergence, number of plants infected, Alectra shoot counts crop damage score, and yield and yield components such as number and weight of pods, weight of 1000 grains and cowpea grain yield are presented in Tables 1 to 8. The result showed that five genotypes: IT97K-499-35, IT98K-573-1-1, IT03K-338-1, IT98K-205-8 and UAM 11D-24-55-3 were consistently free of *Alectra* infestations (Tables 1- 3). The combined year effect on days to *Alectra* emergence showed that Gazum local, TVX3236, Banjar and Borno brown supported significantly the earliest emergence of *Alectra*; while the genotypes IT89KD-373-1-1 and IT84S-246-4 delayed the emergence of *Alectra* by 6 and 4 days , respectively. The non-emergence of *Alectra* in the five genotypes mentioned above confirms the characterization of these genotypes as resistant to *Aletra* infestations (Omoigui *et al*, 2011). This might be the reason for the relatively high yields recorded by these genotypes when compared with reduced yields in the susceptible genotypes. Early emergence of *Alectra* in Gazum local check and other susceptible genotypes confirms that these genotypes are suitable hosts for this parasite (Magani , 1994).

Table 1.Screening of cowpea genotypes on number of days to first *Alectra* emergence at Garkawa, 2011 and 2012 cropping seasons

Cowpea Genotype	Days to Alectra emergence		
	2011	2012	Combined
Banjar	42.67d	43.33c	43.00c
IT84S-246-4	46.33b	47.67b	47.00b
IT97K-499-35	0.00e	0.00d	0.00d
IT98K-573-1-1	0.00e	0.00d	0.00d
IT89KD-391	49.67a	50.00a	49.83a
IT03K-338-1	0.00e	0.00d	0.00d
IT98K-205-8	0.00e	0.00d	0.00d
Borno brown	44.33c	43.00c	43.67c
TVX3236	43.33cd	43.33c	43.33c
UAM11D-24-55-3	0.00e	0.00d	0.00d
Gazum local	43.00d	43.33c	43.17c
SE ±	0.40	0.37	0.35

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability (DMRT)

There were significant differences among the cowpea genotypes in number of crops infested with *Alectra*.

Gazum local and TVX 3236 recorded significantly higher number of crops infested with *Alectra*. Number of crops infested with *Alectra* was highest in Gazum local which was significantly at par with numbers recorded by TVX 3236, Borno brown and Banjar. Similarly, significantly higher *Alectra* shoot counts were recorded in Gazum local and TVX 3236 throughout the period of the observations. The same trend was observed in *Alectra* shoot counts. (Tables 2 and 3). Omoigui *et al* (2007) had reported that Borno brown was highly susceptible to *Striga* with yield loss ranging from 30 to 100% . Magani *et al* (2008) reported highest infestation of *Alectra* on TVX 3236. In the present study, these genotypes that had high number of emerged *Alectra* shoots recorded severe yield losses and gave grain yields that were significantly lower than those of the resistant genotypes (Table 8). This suggests that they are highly susceptible to *Alectra* infestations.

Table 2.Reaction of cowpea genotypes on number of plants infested with *Alectra* at Garkawa , in 2011 and 2012 cropping seasons.

Cowpea Genotype	**Crops infested with *Alectra vogelii* at 9WAS**			**Crops infested with *Alectra vogelii* at 12WAS**		
	2011	**2012**	**Combined**	**2011**	**2012**	**Combined**
Banjar	4.00a	3.33ab	3.67a	14.00a	14.67a	14.33a
IT84S-246-4	2.00c	2.33c	2.17b	8.00b	8.33b	8.17b
IT97K-499-35	0.00d	0.00d	0.00c	0.00c	0.00c	0.00c
IT98K-573-1-1	0.00d	0.00d	0.00c	0.00c	0.00c	0.00c
IT89KD-391	2.00c	2.67bc	2.33b	7.00b	9.00b	8.00b
IT03K-338-1	0.00d	0.00d	0.00c	0.00c	0.00c	0.00c
IT98K-205-8	0.00d	0.00d	0.00c	0.00c	0.00c	0.00c
Borno brown	2.67bc	2.00c	2.33b	13.33a	12.00a	12.67a
TVX3236	3.33ab	3.33ab	3.33a	14.33a	14.67a	14.50a
UAM11D-24-55-3	0.00d	0.00d	0.00c	0.00c	0.00c	0.00c
Gazum local	4.00a	4.00a	4.00a	15.00a	14.67a	14.83a
SE ±	0.33	0.31	0.28	1.07	0.91	0.82

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability (DMRT)

Table 3. Reaction of cowpea genotypes on *Alectra* shoot count at Garkawa , in 2011 and 2012 cropping seasons.

Cowpea Genotype	***Alectra* shoot count at 9WAS**			***Alectra* shoot count at 12WAS**		
	2011	**2012**	**Combined**	**2011**	**2012**	**Combined**
Banjar	8.00bc	8.33b	8.17b	18.33b	23.00a	20.67b
IT84S-246-4	4.67d	4.67c	4.67c	12.33c	12.00b	12.17c
IT97K-499-35	0.00e	0.00d	0.00d	0.00d	0.00c	0.00d
IT98K-573-1-1	0.00e	0.00d	0.00d	0.00d	0.00c	0.00d
IT89KD-391	3.67d	4.67c	4.17c	12.00c	12.00b	12.00c
IT03K-338-1	0.00e	0.00d	0.00d	0.00d	0.00c	0.00d
IT98K-205-8	0.00e	0.00d	0.00d	0.00d	0.00c	0.00d
Borno brown	7.67c	8.67b	8.17b	19.33b	22.67a	21.00b
TVX3236	9.33ab	11.00a	10.17a	21.33ab	25.33a	23.33ab
UAM11D-24-55-3	0.00e	0.00d	0.00d	0.00d	0.00c	0.00d
Gazum local	9.67a	11.00a	10.33a	23.00a	25.67a	24.33a
SE ±	0.53	0.61	0.55	1.02	1.08	0.97

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability (DMRT)

In the two years , crop damage syndrome score differed significantly among cowpea genotypes at 9 and 12 WAS (Table 4). At 9 WAS the combined year effect indicated that plants that were not infested by *Alectra* recorded the least crop damage score; while Gazum local recorded the highest that was not significantly different from Banjar, TVX3236 and IT89KD-391. Howevr, at 12 WAS, TVX3236 and Gazum local recorded the highest crop damage score that was not significantly different from those of Banjar and IT84S-246-4, that was followed by Borno brown

Table 4 C.rop damage score of cowpea genotypes under *Alectra* infestation at Garkawa in 2011 and 2012 cropping seasons.

Cowpea Genotype	**Crop damage score at 9WAS**			**Crop damage score at 12WAS**		
	2011	**2012**	**Combined**	**2011**	**2012**	**Combined**
Banjar	2.67a	2.33bc	2.50ab	3.67a	3.33bc	3.50a
IT84S-246-4	2.00ab	2.33bc	2.17bc	3.67a	3.00cd	3.33a
IT97K-499-35	1.00c	1.00e	1.00d	1.00c	1.00e	1.00c
IT98K-573-1-1	1.00c	1.00e	1.00d	1.00c	1.00e	1.00c
IT89KD-391	2.67a	2.00d	2.33abc	3.67a	2.67d	3.17ab
IT03K-338-1	1.33bc	1.00e	1.17d	1.00c	1.00e	1.00c
IT98K-205-8	1.00c	1.00e	1.00d	1.00c	1.00e	1.00c
Borno brown	2.00a	1.67ed	1.83c	2.67b	2.67d	2.67b
TVX3236	2.67a	2.67ab	2.67ab	3.67a	3.67ab	3.67a
UAM11D-24-55-3	1.00c	1.00e	1.00d	1.00c	1.00e	1.00c
Gazum local	2.67a	3.00a	2.83a	3.33ab	4.00a	3.67a
SE ±	0.25	0.20	0.16	0.26	0.19	0.21

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability (DMRT)

Crop damage score scale (1-5), where 1= normal crop growth; 5 =total scorching or obvious stunted or dead plants

Genotypes that supported higher number of emerged *Alectra* and higher number of crops infested by *Alectra* also recorded lower number of pods/plant, pod weight, 1000 seed weight (Tables 5-7) and subsequently lower grain yield (Table 8). This suggests that reduced photosynthesis can result in a lower number of pods per plant with subsequent reduction in pod weight and grain yield. Press (1995) had reported that *Alectra* infested plants record lower biomass accumulation as a result of competition between the host and parasites for solutes, including carbon and water, and a lower rate of photosynthesis. The higher number of pods and pod weight recorded by IT84S-246-4 compared with other susceptible genotypes could be that this genotype exhibits some level of tolerance to *Alectra*, though it did not translate into a corresponding increase in grain yield. Omoigui *et a*l (2007) had reported cultivars that supported many *Alectra* shoot per plot but still recorded higher grain yields. Magani (1994) had reported tolerance as basis for high cowpea grain yield in VITA-3 in spite of high *Alectra* incidence.

Table 5..Number of pods of cowpea genotypes under Alectra infestation at Garkawa, 2011 and 2012 cropping seasons

Cowpea Genotype	**Number of pods /plot**		
	2011	**2012**	**Combined**
Banjar	177.33e	212.00c	194.67f
IT84S-246-4	478.00a	392.00b	435.00a
IT97K-499-35	384.33ab	395.00b	389.67abc
IT98K-573-1-1	429.33a	520.67ab	475.00a
IT89KD-391	218.00de	190.33c	204.17f
IT03K-338-1	224.67de	408.00b	316.33cde
IT98K-205-8	283.00b-e	615.67a	449.33a
Borno brown	372.33abc	202.33c	287.33def
TVX3236	253.00b-e	406.67b	329.83bcd
UAM11D-24-55-3	340.00a-d	480.00b	410.00ab
Gazum local	234.33cde	231.33c	232.83ef
SE ±	42.93	43.03	29.10

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability (DMRT)

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Table 6. Pod weight of cowpea genotypes under *Alectra* infestation at Garkawa, 2011 and 2012 cropping seasons.

Cowpea Genotype	Pod weight (Kg/ha)		
	2011	**2012**	**Combined**
Banjar	296.30bc	315.50ef	305.90de
IT84S-246-4	481.50abc	533.80de	507.60b-e
IT97K-499-35	1066.70ab	668.60cd	867.70abc
IT98K-573-1-1	925.20ab	1107.90ab	1016.50a
IT89KD-391	444.40abc	282.20ef	363.30de
IT03K-338-1	500.00abc	847.30bc	673.60a-d
IT98K-205-8	518.50abc	1280.40a	899.50ab
Borno brown	314.80bc	183.40f	249.10e
TVX3236	207.40c	295.90ef	251.70e
UAM11D-24-55-3	918.50ab	1192.40a	1055.50a
Gazum local	540.70abc	391.90def	466.30cde
SE ±	187.10	51.19	126.57

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability (DMRT)

Table 7. Weight of 1000 seeds of cowpea genotypes under *Alectra* infestation at Garkawa, 2011 and 2012 cropping seasons.

Cowpea Genotype	1000 seed weight (g)		
	2011	**2012**	**Combined**
Banjar	117.00f	150.00cde	133.50e
IT84S-246-4	128.00ef	130.00def	129.00e
IT97K-499-35	150.33cd	165.00bc	157.67bc
IT98K-573-1-1	166.67bc	150.00cde	158.33bc
IT89KD-391	147.67d	126.67ef	137.17de
IT03K-338-1	186.67a	153.33cd	170.00ab
IT98K-205-8	136.33de	180.00ab	158.17bc
Borno brown	174.67ab	123.33f	149.00cd
TVX3236	73.67f	120.00f	96.83f
UAM11D-24-55-3	147.33de	196.67a	172.00a
Gazum local	178.67ab	130.00def	154.33c
SE ±	4.91	7.81	4.21

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability (DMRT)

Table 8. Grain yield of cowpea genotypes under *Alectra* infestation at Garkawa, 2011 and 2012 cropping seasons.

Cowpea Genotype	Grain yield (Kg/ha)		
	2011	**2012**	**Combined**
Banjar	151.74d	241.90e	196.80ef
IT84S-246-4	352.25cd	391.90e	372.05de
IT97K-499-35	518.70ab	582.30cd	550.48cd
IT98K-573-1-1	590.18a	895.90b	743.05abc
IT89KD-391	256.33cd	228.90e	242.61ef
IT03K-338-1	476.45ab	731.10bc	603.78bc
IT98K-205-8	496.70ab	1240.70a	868.72a
Borno brown	177.73d	114.40e	146.09f
TVX3236	170.03d	258.90e	214.46ef
UAM11D-24-55-3	552.41a	1008.20ab	780.28ab
Gazum local	433.78ab	325.60de	379.67de
SE±	54.76	95.05	64.60

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability (DMRT).

Generally, more grain yield was recorded in most of the genotypes in 2012 against lower yields in 2011. This was probably as a result of higher rainfall during the growth stages of the crop (August and September) and lower rainfall during the productive stage of the crop (October) in 2012 (Fig. 1).

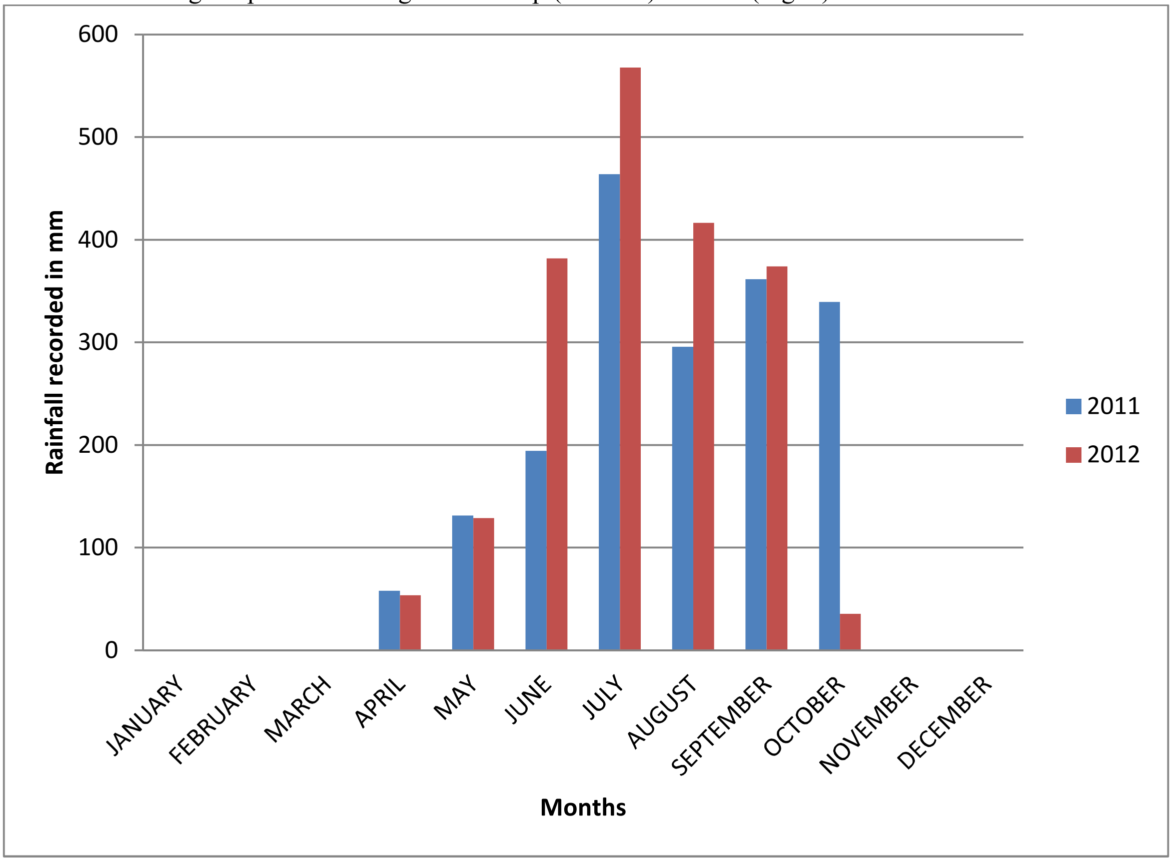

Figure 1: Mean monthly rainfall in 2011 and 2012 in Garkawa

4. Conclusion

This study found significant variations in the levels of infestations with subsequent variations in yield components and grain yield. Five varieties (IT97K-499-35, IT98K573-1-1, IT03K-338-1, IT98K-205-8 and UAM 11D, 24-55-3) were confirmed resistant to *Alectra* in the study area. The Gazum local variety, Banjar, Borno brown, and TVX3236 were found to be very susceptible to *Alectra*; while IT84S-246-4 and IT98KD-391 recorded moderate infestation of *Alectra*. Consequently these very susceptible genotypes will not be suitable for cultivation in Garkawa (within the Southern Guinea Savanna) where *Alectra vogelii* is already endemic. However, genotypes which were consistently resistant to *Alectra,* with corresponding high yields such as IT98K-573-1-1, IT98K-205-8 and UAM11D- 24-55-3 showed promise and are hereby recommended for cultivation by farmers in this study area.

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