



## EFFECT OF IMAZAPYR TREATED MAIZE ON *STRIGA* INFESTATION AND TIME OF INTERCROPPING COWPEA IN SAMARU, NIGERIA

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### ABSTRACT

Two field experiments were conducted at the research farm of Institute for Agricultural Research (IAR) Samaru, Zaria during the 2011 cropping season, with the aim of determining the effect of imazapyr treated maize on *Striga* infestation and time of intercropping cowpea in Samaru, northern guinea savannah of Nigeria. There were two sets of experiments: the first experiment consisted of Six (6) hybrids (AS1128-1, AS1128-2, AS1128-3, AS1128-4, AS1128-6 and AS1128-8) of imazapyr resistant (IR) maize seeds treated with imazapyr chemical and intercropped with cowpea at 2, 4 and 6 weeks after sowing (WAS) of maize. The second experiment consisted of the same Six (6) hybrids of IR maize seeds but untreated and also intercropped with cowpea at 2, 4 and 6 WAS of maize. The experiments were laid out in a split plot design with time of intercropping cowpea as main plot and hybrid maize varieties as sub plot, and replicated three times. The cowpea variety used for the trial was IT97K-499-35. Among the treated IR-maize hybrids, only AS1128-1, AS1128-2, AS1128-3 and AS1128-4 germinated while for the untreated, all the six hybrids germinated. The grain yields per hectare of all the treated maize hybrids did not significantly differed whereas grain yields per hectare of the untreated maize hybrids AS1128-1, AS1128-2, AS1128-3 and AS1128-4 were significantly higher than the hybrid AS1128-8. The treated IR maize hybrids exerted 100% control of *Striga* while the untreated supported *Striga* emergence. There was no visible damage symptoms observed on the cowpea intercropped with treated maize at all times of intercropping. It is therefore concluded that the IR-maize hybrids AS1128-1, AS1128-2, AS1128-3 and AS1128-4 should be used in the treated forms for the control of *Striga*. Moreover, the intercropping of cowpea with imazapyr treated maize can be carried out starting from 2 WAS of maize.

**Key words:** Intercropping, imazapyr resistant maize (IR-maize), cowpea, *Striga*.

### INTRODUCTION

Maize (*Zea mays* L.) is one of the major food crops widely grown from the wet climate of the coast to the dry Sudan savannas of West and Central Africa. The yield potential of maize is particularly high in the savanna belt of this zone due to favourable growing conditions and reduced incidence of pests and diseases. *Striga* poses a serious threat to maize production in the high potential areas of the African savannas (Kim, 1991, Kling *et al.*, 2000). Among the numerous species of *Striga* that are endemic to the savannas of Africa, *Striga hermonthica* (Del.) Benth is the most widespread and destructive species affecting cereals, with maize being the most susceptible (Kim, 1991, Berner *et al.* 1995). In maize croplands alone, *Striga* infests over 2.3 million hectares resulting in 1.6 million tons of grain loss worth US \$383 million annually (Woomer and Savala, 2007). It affects the livelihood of some 300 million people in Africa with 17 countries seriously affected and further 25 experiencing moderate damage (M'boob, 1989). In northern Nigeria, Berner *et al.* (1997) reported that over 85% of fields planted to maize and sorghum are infected with *Striga*.

One possible way to suppress parasitic weed emergence and prevent damage to the existing crop is by using herbicides that inhibit the activity of acetolactate synthase (ALS) (Garcia-Torres and Lopez-Granados, 1991; Abayo *et al.*, 1996). These herbicides work by specifically inhibiting the biosynthesis of branched chain amino acids in the plant (Saari *et al.*, 1994). Examples include imazapyr (Abayo *et al.*, 1996), Sulfonylureas (Adu-Tutu and Drennan, 1991) or imazaquin (Berner *et al.*, 1997). The herbicide is applied to maize that has target site resistance to the herbicide activity such that when it is coated, it absorbs some of the herbicide during germination and stimulates the germination of *Striga* which will then be killed before it can cause any damage. Maize with acetolactate synthase (ALS) inhibiting herbicides resistance was developed from tissue culture mutation (Newhouse *et al.*, 1991). These herbicides may be applied to seed, such that low dosages in the range of 10 - 30g active ingredient ha<sup>-1</sup> are possible to control *Striga* effectively (Abayo *et al.*, 1996; Berner *et al.*, 1997).

In Nigeria, most maize is grown in association with legumes particularly cowpea and there are concerns that the imazapyr chemical used to treat maize seeds may inhibit or reduce the germination and performance of cowpea since it is not resistant to imazapyr chemical. Due to these reasons, it becomes necessary to evaluate the performance of cowpea intercropped with imazapyr treated maize with a view to find the appropriate time of intercropping cowpea with treated maize.

## MATERIALS AND METHODS

Field experiment was conducted during the 2011 rainy season at the Research farm of Institute for Agricultural Research (IAR), Samaru, Ahmadu Bello University, Zaria (Latitude 11° 11'N and Longitude 7° 38'E, 686m above sea level). There were two sets of experiments: In the first experiment, Six (6) hybrids of imazapyr resistant (IR) maize seeds (AS1128-1, AS1128-2, AS1128-3, AS1128-4, AS1128-6 and AS1128-8) treated with imazapyr chemical intercropped with cowpea (IT97K-499-35) at 2, 4 and 6 weeks after sowing (WAS) of maize. The second experiment consisted of the same Six (6) hybrids of IR maize seeds but untreated and also intercropped with cowpea at 2, 4 and 6 WAS of maize. The experiments were laid out in split plot design with time of intercropping cowpea as main plot and hybrid maize varieties as sub plot, and replicated three times.

The field was harrowed and made into ridges of about 75cm apart, the plots were then laid out according to treatments. The *Striga*-Sand mixture was made at a ratio of 10g to 1000g of *Striga* and sand respectively, each planting hole received 10g of the mixture (inoculum) at planting. Three maize seeds were carefully placed on the *Striga* inoculum in the planting hole and covered gently at an intra row spacing of 50cm and later thinned to one plant per hill at 2 weeks after sowing (WAS). Also, three cowpea seeds were planted between two maize plants which is equivalent to 50cm between two stands of cowpea at 2, 4 and 6 WAS of the maize seeds, and later thinned to one plant per hill. The fertilizer was band applied at the rate of 30kg/ha each of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O at planting and an additional 30kgN/ha was applied in form of urea (46%) as top dressing at 5 WAS of the maize crop. The number of emerged *Striga* were counted from the net plot at 10 and 12 weeks after sowing (WAS) and the visual damage symptoms of *Striga* were observed and rated at 10 and 12 WAS of maize by using a scale of 1 to 9, where 1 = no visible symptoms and 9 = all leaves completely scorched resulting in premature death as described by Kim *et al.*, (2002). Data were also taken on grain yield and 100 seed weight for both the maize and cowpea plants. The data generated were subjected to analysis of variance (ANOVA) as described by Snedecor and Cochran (1967) using GenStat (GenStat, 2011).

## RESULTS AND DISCUSSION

### Number of emerged *Striga*

Table 1 shows that the *Striga* did not emerge at 10 and 12 WAS in the treated maize hybrids, whereas

for the untreated, hybrids AS1128-6 recorded higher number of emerged *Striga* with 38 and 56 *Striga* plants at 10 and 12 WAS, respectively. These were closely followed by the hybrid AS1128-8 that supported 24 and 30 *Striga* plants in the respective sampling period. The remaining hybrids supported insignificant number of *Striga* plants that ranged from 5 to 7 at 10 WAS, and 8 to 10 at 12 WAS. The absence of *Striga* on treated maize hybrids could be attributed to the chemical protection of the seeds by imazapyr, which is in agreement with the findings of Berner *et al.* (1997) and Kanampiu *et al.* (2009) in their separate studies, which demonstrated that IR-maize seed dressed with imazapyr has been successfully used in the control of *Striga* plant.

### *Striga* damage rating

There were no visible *Striga* damage symptoms on the treated hybrids at 10 WAS, but at 12 WAS, *Striga* damage symptoms were observed in which hybrids AS1128-1 and AS1128-4 recorded significantly higher *Striga* damage scores than the other hybrids (Table 1). Among the untreated hybrids, the AS1128-8 showed higher *Striga* damage score (4.2) than the other hybrids at 10 WAS. At 12 WAS the hybrid AS1128-8 recorded higher damage score (6.4) than the other hybrids followed by AS1128-6 (4.3). The hybrids AS1128-1, AS1128-2, AS1128-3 and AS1128-4 had statistically similar and lower *Striga* damage scores. Kanampiu *et al.* (2001) demonstrated that, imazapyr coated maize seeds exude germination stimulants into the rhizosphere thereby inducing germination of *Striga* seeds, which were consequently killed. Also, the relatively less *Striga* damage symptoms observed on the untreated IR-maize was in agreement with the findings of Menkir *et al.* (2009) which revealed that hybrids formed from selected IR-maize inbred lines with field resistance to *S. hermonthica* sustained less damage symptoms under *S. hermonthica* infestation and supported fewer emerged parasites than the susceptible hybrid check.

### 100 kernel weight (g)

Table 2 shows that the treated hybrid AS1128-1 recorded significantly higher 100 kernel weight which was statistically at par with AS1128-2 while hybrid AS1128-3 recorded the least 100 kernel weight. Among the untreated maize, hybrid AS1128-2 recorded highest 100 kernel weight followed by AS1128-1 and AS1128-6. The hybrid AS1128-8 recorded the lowest 100 kernel weight. Arnon (1972) reported that different cultivars grown under the same conditions may have differences in their performance due to genetic make up.

### Kernel yield (kg ha<sup>-1</sup>)

There were no significant differences among the kernel yield per hectare of the treated hybrid maize (Table 2). Among the untreated hybrids however, AS1128-1, AS1128-2, AS1128-3 and AS1128-4 recorded significantly higher kernel yield per hectare with yield ranged from 2613.1kg for hybrid AS1128-1 to 2717.8kg for hybrid AS1128-2. The hybrid AS1128-8 recorded the least (1474.8kg) kernel yield per hectare.

This could be due to differences in the ability of the hybrids to exploit resources especially water and nutrients (Falconer, 1989). Also, the kernel yield performance of the treated maize is in agreement with the findings of Kanampiu *et al.* (2001) who observed that treated IR-maize gave higher kernel yield than the untreated ones.

**100 grain weight and grain yield of intercropped cowpea**

Table 3 shows that the cowpea intercropped with treated maize has germinated and produced successfully, this was in agreement with the findings of CIMMYT (2008) which reported that, the low dose herbicide seed dressing on IR maize will control *Striga* without having severe damage on the crop intercropped at 10cm or more from the maize hills. The cowpea intercropped at 4 and 6 WAS were at par in both experiments and produced significantly higher 100 grain weight than intercropping at 2 WAS. A statistically similar cowpea grain yield was produced when the cowpea was intercropped with treated maize hybrid, whereas the cowpea intercropped with untreated maize at 2 WAS produced significantly higher grain yield than other times of intercropping. Generally, the cowpea intercropped at 2 WAS

produced highest grain yield in both treated and untreated maize. This was probably due to the fact that introducing cowpea earlier may allow the crop to make full use of soil moisture during the cropping season and also to utilize solar radiation more efficiently since it was introduced at the early stage of maize growth. Dhital *et al.* (1997) reported that early planting of cowpea resulted in higher number of pods per plant and number of seeds per pod.

**Conclusion**

The findings of this study revealed that, among the treated IR-maize hybrids planted only ASII28-1, ASII28-2, ASII28-3 and ASII28-4 germinated and performed better than the untreated hybrids. Also the untreated IR-maize hybrids evaluated sustained relatively less yield loss due to their resistance to *Striga* except ASII28-8 which recorded a poor performance.

The study showed that the IR-maize hybrid ASII28-1, ASII28-2, ASII28-3 and ASII28-4 in their treated form can be used to achieve a maximum *Striga* suppression. Also, these findings clearly showed that intercropping of cowpea with imazapyr treated maize is feasible starting from 2 WAS.

**Table 1: Effect of time of intercropping and IR-maize hybrids on numbers of emerged *Striga* and *Striga* damage rating at 10 and 12 WAS of maize at Samaru, 2011.**

Treatment	numbers of emerged <i>Striga</i>				<i>Striga</i> damage rating			
	10 WAS		12 WAS		10 WAS		12 WAS	
	treated	untreated	treated	untreated	treated	untreated	treated	untreated
<b>Time of intercropping (T) (WAS)</b>								
2	0.0	10.2	0.0	15.1	1.0	2.5	1.8	3.7
4	0.0	21.8	0.0	32.2	1.0	2.6	1.3	3.6
6	0.0	10.4	0.0	13.1	1.0	2.1	1.5	2.8
SED	0.00	1.88	0.00	4.79	0.00	0.31	0.23	0.21
<b>Hybrids maize (H)</b>								
ASII28-1	0.0	7.3b	0.0	10.2b	1.0	2.0bcd	1.8a	2.6c
ASII28-2	0.0	4.8b	0.0	7.8b	1.0	1.4d	1.1c	2.0c
ASII28-3	0.0	5.1b	0.0	7.9b	1.0	2.2bc	1.4b	2.7c
ASII28-4	0.0	5.8b	0.0	9.0b	1.0	1.9cd	1.9a	2.2c
ASII28-6	-	37.8a	-	56.0a	-	2.6b	-	4.3b
ASII28-8	-	24.1ab	-	29.8ab	-	4.2a	-	6.4a
SED	0.00	6.78	0.00	16.36	0.00	0.44	0.16	0.52
<b>Interaction</b>								
T x H	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using DMRT. - not germinated, NS = not significant.

**Table 2: Effect of times of intercropping and IR-maize hybrids on 100 kernel weight and kernel yield of maize at Samaru, 2011.**

Treatment	100 kernel weight (g)		Kernel yield (kg/ha <sup>-1</sup> )	
	treated	untreated	treated	untreated
<b>Time of intercropping (T) (WAS)</b>				
2	24.7	23.3	2204.2	2231.0
4	25.8	22.4	2953.7	2378.0
6	27.5	24.9	2621.2	2567.0
SED	1.38	0.91	2.3.36	205.7
<b>Hybrid maize (H)</b>				
ASII28-1	28.3a	25.4ab	2690.6	2613.0a
ASII28-2	27.3ab	26.5a	2672.7	2718.0a
ASII28-3	23.2c	23.2b	2596.5	2686.0a
ASII28-4	25.0bc	23.4b	2412.5	2688.0a
ASII28-6	-	24.6ab	-	2172.0b
ASII28-8	-	18.0c	-	1475.0c
SED	1.30	1.46	173.62	243.5
<b>Interaction</b>				
T x H	NS	NS	NS	NS

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using DMRT. – not germinated, NS = not significant.

**Table 3: Influence of time of intercropping cowpea and IR-maize hybrids on 100 grain weight and grain yield of cowpea at Samaru, 2011.**

Treatment	100 grain weight (g)		Grain yield (kg/ha <sup>-1</sup> )	
	treated	untreated	treated	untreated
<b>Time of intercropping (T) (WAS)</b>				
2	13.4b	13.6b	364.3	199.4a
4	17.8a	16.4a	364.2	123.2b
6	18.1a	16.2a	258.1	84.2c
SED	0.89	0.76	106.1	26.06
<b>Hybrid maize (H)</b>				
ASII28-1	15.5	15.6	272.0bc	109.1
ASII28-2	17.5	15.5	221.0c	114.4
ASII28-3	16.8	15.0	250.0c	109.0
ASII28-4	15.9	15.6	268.0bc	133.0
ASII28-6	16.3	14.0	372.0ab	139.4
ASII28-8	16.7	16.3	398.0a	141.1
SED	1.03	1.02	95.9	36.07
<b>Interaction</b>				
T x H	NS	NS	NS	NS

Means followed by the same letter within a column are not significantly different at 5% level of probability using DMRT. – not germinated, NS = not significant.

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