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EFFECTS OF *STRIGA GESNERIOIDES* ON THE GROWTH AND YIELD OF SOME COWPEA (*VIGNA UNGUICULATA* (L.) WALP) GENOTYPES UNDER WATER STRESS CONDITION

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ABSTRACT
Cowpea production in the Sahelian region faced production constraint due to disease and drought. Striga gesnerioides is a major constraint to cowpea production specifically to the agronomic point of view. The aim of this present study is to determine the effect of Striga gesnerioides on the growth and yield of some cowpea genotypes subjected to different moisture stress conditions. The experiment was conducted at screen house of the International Institute of Tropical Agriculture (IITA) Kano, Nigeria. Three cowpea varieties were used in the experiment, the experimental set up was completely randomized design with four treatment regimes; T1, vegetative stage of water stress with Striga infestation; T2, vegetative stage of water stress; T3, unstressed with Striga infestation and T4, unstressed. Uniform broadcasting of 0.05g of Striga gesnerioides were imposed in the treatment. Data were collected on plant height, number of leaves, plant vigor score, phenology, and grain yield. The results showed that there is a significant difference in the number of leaves between the treatments with DANILA having the highest number of leaves. DANILA was found to exhibit the highest plant vigor. Total chlorophyll reductions were recorded at 37 days after water stress and striga infestation.DANILA recorded the highest reduction in total chlorophyll content. The results showed that IT98K-205-8 matured earlier and recorded higher yield, Danila recorded low yield. It can be concluded that cowpea varieties IT97K-499-35 and IT98K-205-8 which gave the highest yield were resistance to Striga gesnerioides, whereas Danila which developed Symptoms with reduced yield is said to be susceptible to Striga gesnerioides.

Keyword: Striga gesnerioides, cowpea, water stress

INTRODUCTION

Parasitic weeds are serious problems in many agricultural systems in the tropics. *Striga a*lso known as "witchweed" is an angiospermic, hemi-parasite belonging to the family orobachaceae (formerly scrophulariaceae). There are about 30 species or more of *Striga* described, but only 5 are presently of economic importance in Africa. These include, S*triga hermonthica* (Del) Benth, *Striga asiatica L.* Kuntze*, Striga gesnerioides* (Wild) Vatke, *Striga aspera* Benth, and *Striga forbesii* Benth. All these, except *Striga gesnerioides* are parasitic to African cereal crops and these include maize, rice, millet and sorghum. *Striga gesnerioides* is a parasite of cowpea and other wild legumes (Berner *et al*, 1997).

Striga gesnerioides has greater impact on human welfare than any other parasitic angiosperms because their hosts are subsistence crops in areas marginal for agriculture (Singh 2000). As a parasite, *Striga* is entirely dependent on its host. An exudates from roots of the crop plants stimulate germination of *Striga* seed. The sprouting seeds attach themselves to the root of the host crop and draw nutrients for their own growth. Farmers recognize two types of *Striga* damage (underground and above ground) with greater damage being caused by the underground *striga. Striga* undergoes considerable development underground at the expense of its host, by the time *striga* emerged at the soil surface they may have devastated the crop. In this way hosts are "bewitched" because the farmers are unaware of the parasite until it comes up. S*triga* parasitic weeds are considered to be one of the major biological constraints to food production in Sub- Saharan Africa, probably a more serious agricultural problem than insects, birds or plant diseases (Singh 2000). *Striga gesneriodes* attacks cowpea in west and Central Africa, particularly in the Sahel and Sudan savanna zones (Musselman and Parker, 1982; Ramaiah *et al*., 1983). It is also found in coastal savanna along the Atlantic ocean as well as on sandy or shallow gravelly soils in the Guinea Savannas in Benin, Ghana,Togo and Sierre Leone (RENACO, 1990). In northern Nigeria, *Striga* may cause cowpea yield losses varying from few Kg ha^{-1} to total crop failure (Obilana, 1987). According to Emechebe and Leleji (1988) this had also led to abandonment of striga infested fields to cowpea production.

Striga tolerates a relatively wide range of climatic and soil conditions. It grows in areas with annual rainfall ranging from 25 to 150cm per year with increased severity of infestation in areas with low rainfall (Musselman and Ayensu, 1984), poor soil fertility and continuous cropping of the host crop.

The purpose of the present study is to determine the effect of *Striga gesnerioides* on the growth and yield of some cowpea genotypes subjected to different moisture stress conditions.

MATERIALS AND METHODS

The experiment was conducted in the screen house at the International Institute of Tropical Agriculture (IITA) located at 12^0 03N latitude and 8^0 32E longitude, Kano, Nigeria.

Experimental treatment and *Striga* infestation

The experiment comprised of four treatment regimes and these include; T1, water stress with *Striga* infestation; T2, severe water stress; T3, unstressed with *Striga* infestation and T4, unstressed. *Striga gesnerioides* infestation was done by mixing 0.9g of *Striga gesnerioides* with 18 scoops of sterilized, sieved soil and each pot was then infested with 1 scoop of the mixture which is equivalent to 0.05g of *Striga*. They were arranged in a completely randomized design. The water stress was imposed at vegetative stage and watering was done twice per week for the control pots.

Planting

Thirty three pots of 18.6cm size containing sterilized soil were used. The infested soil was watered 24 hours before planting. Three holes of 2-3 cm depth were made in each pot and one seed were sown into each hole making three seeds per pot. Two weeks after planting, the plants were thinned to maintain one plant per pot.

Total of 0.36g of N.P.K fertilizer (15:15:15) was obtained and was dissolved in a beaker containing 360ml of water. 10ml of the dissolved solution was then broadcasted into each pot using a syringe.

DATA COLLECTION

Vegetative Growth

Measurement of vegetative growth includes plant height, number of leaves, and plant vigor scores (1-5), Whereby 1= very poor, 2= poor, 3= average, 4= good and 5= very good (Amede *et al*., 2004)

Physiological Measurement

Chlorophyll Content

The total chlorophyll content was measured using Minolta chlorophyll SPAD 502 meter and measurements were taken at the initial, 20 and 37 days after water stress induction. Average of three SPAD readings were reported in each pot.

Phenology

The phenological measurement include, Days to first open flower (DFF), days to 50% flower opening (DT50%F) and number of days to maturity (DTM).

Grain Yield

Number of pods, pod weights and number of seed per plant were estimated at the physiological maturity.

Statistical analysis

Statistical analysis was performed using Genstat 3 edition, data were subjected to analysis of variance. Means were separated using least significant difference at 5%.

RESULTS

Vegetative Growth

The result indicates that the highest reductions in plant height were recorded in IT97K-499-35 under T1 and T2 respectively. Lowest reduction in plant heights were exhibited by IT98K-205-8 (Fig. 1)

The mean values also showed that there was a significant difference in the number of leaves between the treatment, genotype and genotype treatment interaction. Danila recorded the highest number of leaves. Numbers of leaves were significantly reduced under vegetative stage and *Striga* infestation with vegetative stage of water stress respectively. An increase in number of leaves was recorded under IT98K-205-8 at vegetative stage with *Striga* infestation treatment (Fig 2). The result for plant vigor score showed that DANILA, IT97-499-35 were lower under vegetative stage of water stress and vegetative + striga infestation. Local variety DANILA recorded higher plant vigor. Under unstressed +striga infestation all the varieties exhibited higher plant vigor (Fig. 3).

Physiological Parameter

Chlorophyll content

The total chlorophyll content at initial stress induction was relatively similar to unstressed treatment. There is a general reduction in the total chlorophyll as water stress increased to 37 days after stress induction. The highest reductions in total chlorophyll content were exhibited under T1 and T2 respectively (Table 1). DAN'ILA recorded the highest reduction under T1 and T2.

Grain Yield

Days to first flower, Days to 50% flower opening and number of days to maturity in Figs. 4 and 5 showed that variety IT98K-205-9 recorded no flower under vegetative stage of water stress, but recorded in increase of days to flower under vegetative stage with *Striga* infestation. However DANILA recorded no flower under vegetative stage of water stress with *Striga* infestation. Variety IT97K-499-35 recorded higher number of flowers under unstressed with *Striga* infestation.

The grain yield component in table 3, indicate that IT98K-205-8 recorded the highest grain yield under vegetative stage and unstressed with *Striga* infestation. DANILA, recorded lower grain yield under vegetative stage of water stress with *Striga* infestation.

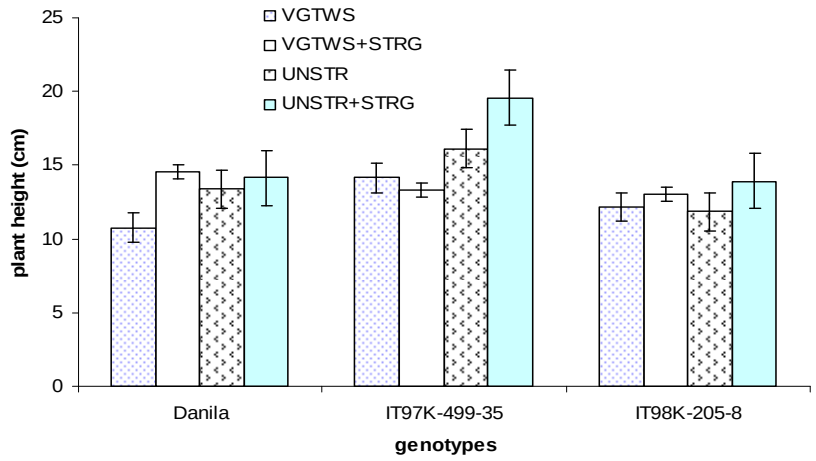

Figure 1: plant height of cowpea genotypes under different moisture regimes and *S*triga infestation, vertical bar represents ± SE with three replications.

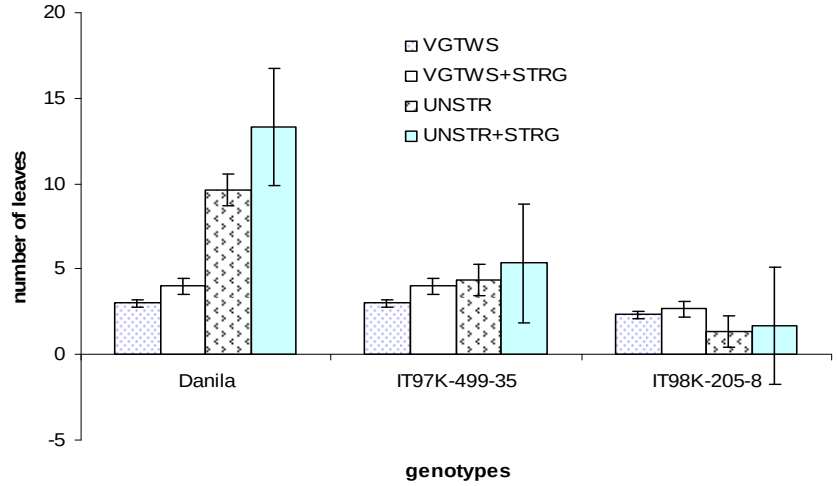

Figure 2: Number of leaves of cowpea genotypes under different moisture regimes and Striga infestation, vertical bar represents ± SE with three replications

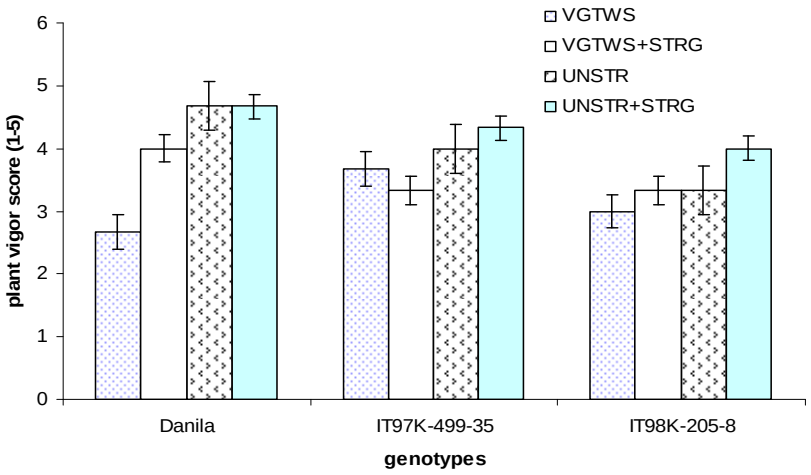

Figure 3: plant vigor scores (1-5) of cowpea under different moisture regimes and striga infestation, vertical bar represent ± SE with three replications

Table 1. Mean total Chlorophyll content at initial, 20 and 37 days after water stress induction of cowpea genotypes under different moistures stress and striga infestation.

	Initial stress				20Dasi				37Dasi			
Genotype	**vgtws**	**vgtws+strg**	**unstr**	**unstr+strg**	**vgtws**	**vgtws+strg**	**unstr**	**unstr+strg**	**vgtws**	**vgtws+strg**	**unstr**	**unstr+strg**
Danila	45	30	40.9	39.7	30.6	37.1	37.2	37.5	20.5	24.9	33	31.4
IT97K-499-35	39.5	36.1	53.2	48.6	19.2	26.9	38.8	39.1	26.5	29	52.8	36.6
IT98K-205-8	33.8	41	49.7	54	25	39.7	25.9	22.2	25.6	35.2	40.1	45.2
Mean	39.4	35.7	47.9	47.4	24.9	34.6	34	33	24.2	29.7	42	37.7
LSD	11.15	NS	11.32	29.49	17.19	NS	NS	13.22	NS	NS	9.18	12.2

Key: LSD, least significant difference at 5%; vgtws, vegetative stage of water stress; vgtws+strg, vegetative stage of water stress with striga infestation; unstr, unstressed; unstr+striga, unstressed and striga infestation; Dasi, days after water stress induction

Table 2. Mean total number of pods, pod weight (g/plant) and seed weight (g/plant) of cowpea grown under different stage of water stress and striga infestation

	Pd_No				Pdw				Seed_No			
Genotype	**vgtws**	**vgt +strg**	**unstr**	**unstr+strg**	**vgtws**	**vgt +strg**	**Unstr**	**unstr+strg**	**vgtws**	**vgt +strg**	**unstr**	**unstr+strg**
Danila	0.33	0.00	0.66	0.33	0.18	0.00	0.70	0.14	2.00	0.00	5.67	1.00
IT97K-499-35	0.33	0.33	1.33	1.33	0.15	0.12	1.39	0.88	2.00	0.67	9.67	6.00
IT98K-205-8	0.00	0.66	1.66	1.66	0.00	0.29	1.18	1.46	0.00	2.33	5.33	7.67
mean	0.22	0.33	1.22	1.11	0.11	0.14	1.09	0.83	1.33	1.00	6.89	4.89
SE	0.11	0.19	0.29	0.40	0.06	0.08	0.20	0.38	0.66	0.69	1.39	2.00

Pd No, pod number; Pdw, pod weight; SE, standard error; vgtws, vegetative stage of water stress; vgtws+strg, vegetative stage of water stress with striga infestation; unstr, unstressed; unstr+striga, unstressed and striga infestation

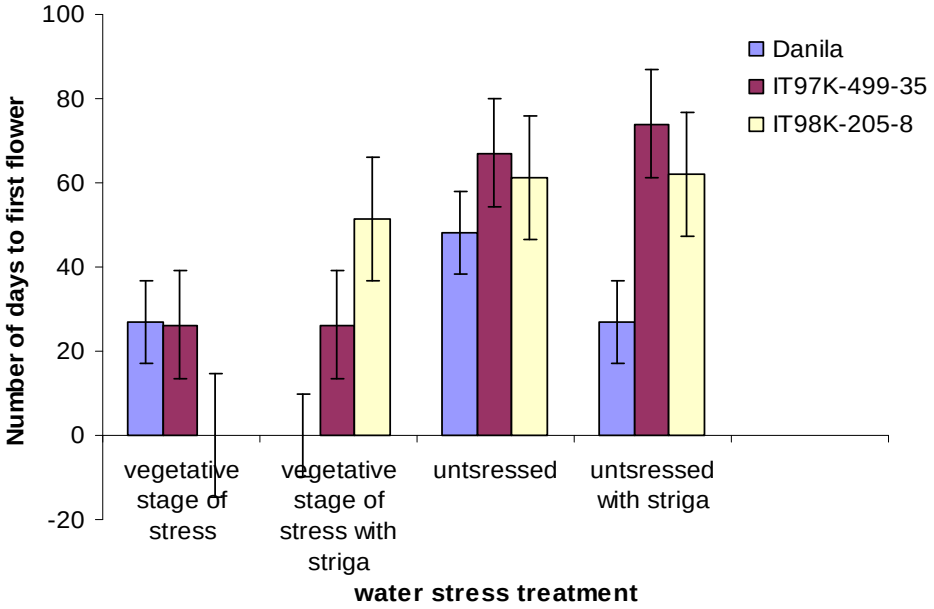

Figure 4 Number of days to first emergence of flower of cowpea under different stage of water stress with *Striga* infestation, vertical bar represent ± SE with three replication.

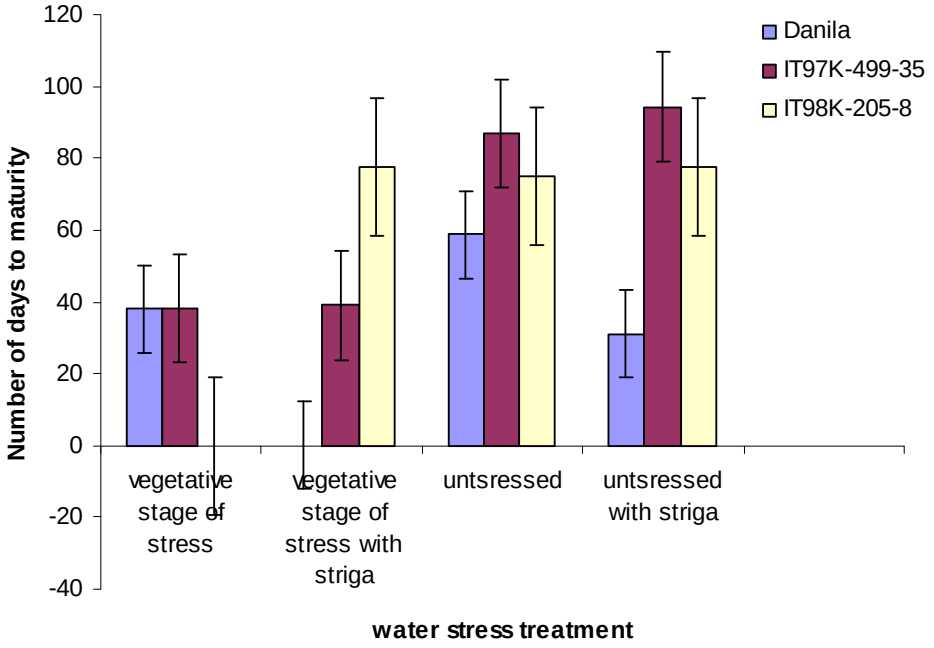

Figure 5 Number of days to maturity of cowpea under different stage of water stress with *Striga* infestation, vertical bar represent ± SE with three replication.

DISCUSSION

In this study there was a significant difference observed between the three cowpea varieties IT97K-499-35, IT98K-205-8 and Danila in response to infestation *Striga gesnerioides* and drought stress. IT97K-499-35 and IT98K-205-8 were found to be completely tolerant to *Striga gesnerioides* and drought whereas Danila was found to be susceptible as it developed symptoms of *Striga* infection. The symptoms included leaf chlorosis, reduced vigor and partial defoliation as observed in DAN"ILA. Emechebe *et al. (*1991) reported that symptoms of *Striga* infection can be noticed much before its emergence above the ground.

Wilting with reduced number of flower and pods as well as general stunting as reported by Mugabe (1983). However, despite being susceptible to *Striga gesnerioides,* Danila was found in this study to grow higher than IT97K-499-35 and IT98K-205-8. Also in the number of leaves and the plant vigor Danila scored higher these indicate that drought at early stage does not affect the growth of cowpea.

The major factor which may account for the reduced growth of the susceptible cowpea variety is the low chlorophyll content which reduced the rate of photosynthesis and result in decreased yield (Graves *et al.,* 1992). This phenomenon has also been reported for both cereals infected with *Striga hermonthica* and for *Vigna unguiculata* (cowpea) infected with *Striga gesnerioides* (Graves *et al.,* 1992). There is total grain yield loss observed under drought stress. This shows that when there is drought, the impact of *Striga gesnerioides* becomes even more significant.

CONCLUSION

It can be concluded that cowpea varieties IT97K-499-35 and IT98K-205-8 which gave the highest yield were resistance to *Striga gesnerioides,* whereas Danila which developed Symptoms with reduced yield is said to be susceptible to *Striga gesnerioides.*

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