Electronic Journal of Plant Breeding, 1(3): 250-253 (June 2010)

Research Article

Relationship between moisture tolerance versus yield and yield components in Cowpea

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Abstract :
The experiment was carried out to exploit the broad spectra of genetic variability in cowpea germplasm for improvement of high moisture tolerance. Twenty-five germplasm lines of diverse genteic background with three local cultivars were involved in the evaluation over two cropping seasons (early and late) under rainfall conditions across two locations in 2006. The experiments were conducted in the Teaching and Research Farm, Ambrose Alli University, Ekpoma (Lat. 6° 08′ E and Long. 6° 42′ N) in a rain forest–savanna transition area with mean annual rainfall of 1200mm to 1556mm; and at Benin–Owena River Basin Development Authority, Obayantor, near Benin (Lat. 6° 09′ 24″and Long. 5° 35′ 27″ E) in the humid rainforest area with mean annual rainfall of 2032mm to 2540mm. RCBD with three replications was used. Significant negative relationship (r) existed between moisture tolerance and pods per plant, seeds per pod and grain yield which indicated that as severity of moisture level in the soil increased with time, susceptibility level of the germplasm also increased with a consequent reduction in the number of pods per plant, number of seeds per pod and grain yield. Seeds per pod and 100–seed weight were recognized as the common attributes for grain yield and selection be done based on these traits for improvement of cowpea for high moisture stress.

Key words:
Cowpea germplasm, moisture tolerance, relationship, grain yield.

Introduction

High soil moisture caused by poor soil drainage is one of the most important production constraints for cowpea crop in Southern Nigeria. Moisture stress affects crop phenology and leaf area development that finally culminates in low seed yield (Haqqani and Pandey 1994). Several researchers revealed that cowpeas as a species are more waterlogging tolerant (Minchin and Summerfield 1976) than other major grain legumes. Umaharan (1990) has however reported that genetic variability for tolerance to waterlogging could be used as a selection criterion in breeding varieties for environment prone to high moisture. Maintenance of saturated soil throughout the growth cycle has been reported to improve water relation of soybean resulting in increased photosynthesis and yield (Summerfield and Lawn, 1987). However, Srinivasan *et al.* (2004) reported that most of the time,average rainfall during the cropping season may appear stable, but weekly precipitation levels are highly variable resulting in the crop having both excess and deficit moisture at critical stages of crop growth in one cropping season.

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The identification of grain yield components is of utmost importance to the plant breeder in cowpea. Thus, correlation analysis provides a measurement of relationship between characters which serves to evaluate the mutual improvement of two charcters by common selection and used to determine the possibility of selection for one character to identify the genotypes with superior expression of a correlated character (Raje and Rao, 2000).

The present study is an effort to estimate the performance of yield and its components as affected by high soil moisture stress in cowpea selection and the potentiality for breeding programme in the South as most breeding works so far conducted by research institutions are targeted to the semi–arid (drought limited) regions of Nigeria.

Material and Methods

Twenty-five lines of cowpea germplasm of diverse genetic background obtained from IITA, Ibadan, Nigeria along with three other local cultivars were sown at two different locations in Ekpoma (Teaching and Research Farm) Ambrose Alli University and Benin–Owen River Basin Development Authority, Obayantor, near Benin on 1st and 6th May (early season); 7th and 12th Augusgt (late season), 2006, respectively. Ekpoma (Lat. 6° 08′ E and Long. 6° 42′ N) recorded mean annual precipitation of 1200mm

to 1556mm and Obayantor (Lat. 6° 09′ 24″and Long. 5° 35′ 27″ E) recorded mean annual precipitation of 2032mm to 2540mm. Both locations experience a bimodal rainfall distribution pattern.

The cowpea germplasm were evaluated in a randomized complete block desing (RCBD) in three replications with 3m×2m plot size with 1m inter–plot discards. Plant spacing was 60cm inter– and 30cm intra–rows with two seeds per hole and later thinned to one seedling per hill two weeks after sowing (WAS). Visual observations of assessment under field condition of cowpea plants for moisture tolerance commenced from the fourth week after sowing at weekly intervals. Tolerance scale rating of 1–9 (IBPGR, 1983) was used to score stress susceptibility level where 1–3 (tolerance/not susceptible); 4–6(medium tolerance); and 7–9 (highly susceptible). All agronomic and plant protection practices were adopted. Correlation matrix was performed between moisture tolerance and yield components.

Results and Discussion

Like successful cultivars of any crop species, successful cowpea genotypes must be adapted to a wide range of climatic and edaphic conditions. Tolerance to high soil is one of the major biophysical factors that influences the adaptation and performance of cowpea genotypes in different locations. In this study an attempt has been made to recognize the major yield components in cowpea genotypes cultivated under field conditions and the effect of high moisture stress on these component characters (Table 1).

Moisture tolerance had a significant negative relationship effect on pods per plant, seeds per pod and grain yield. Generally, it indicates that as moisture in the soil increased with time, the susceptibility level of the genotypes also increased. Leaf area index (LAI) in the study (Table 1) revealed significant positive correlation with plant height and grain yield iindicating that the larger the LAI value, the larger the growth in plant height development and the higher the final yield that could be attained. Previous finding had reported highly correlated LAI with seed yield in navybeans (*Phaseolus vulgaris*)(Gunton and Everson, 1980). Days to 50% flowering had significant positive relationship with number of seeds per pod and 100–seed weight. Number of pods per plant had been reported with high genetic variability in cowpea (Tyagi *et al.,* 2000). There was highly significant positive interrelationship of pods per plant with pod weight, seeds per pod, seed weight and yield (Table 1). The high correlation of pods per plant with these attributes could be attributed to better distribution of rainfall during the reproductive phase and through indirect effect of branch number (especially for the indeterminates). Moreover, the significant relationship observed indicated that the character could be selected for among the genotypes tested in this study particularly when yield is the primary objective. A non–significant correlation of pod length with yield, seed weight and seeds per pod was observed (Table 1). The low positive insignificant relationship of pod length character with yield and yield related components indicates that as the pod length is shortened, lesser space for seeds is being provided in the pods. Pod weight showed no significant relation with seeds per pod, 100–seed weight and grain yield. Kamara (1976) reported that pod weight was greatly affected by deficient soil moisture. The non–significant relation of pod weight with any of the yield and its components in this study would imply that pod weight character may not be a major attribute in the determination of the final seed yield in cowpea genotypes.

Seeds per pod had been reported to be negatively correlated with seed weight which would suggest that as more seeds are produced per pod, the average seed size should decrease because of competition among seeds for food reserves (Nakawuka and Adipala, 1999). However, this study revealed high positive significant associations of seeds per pod with 100–seed weight and grain yield, respectively. This may possibly indicate that the genotypes were responsive to changing environments for the character. Okeleye *et al.* (1999) had previously reported positive significant association of seeds per pod with grain yield.

In Table 1, the correlation matrix showed the high positive relationship between 100–seed weight and grain yield which indicates that 100–seed weight was directly influenced by the positive effect of seeds per pod. Seeds per pod and seed weight were recognized as the common attributes for grain yield in this study. As a result, the significant positive relationship observed indicated that these characters could be selected in the cowpea genotypes used particularly when seed yield is the object of improvement, bearing in mind the association between characters conferring high soil moisture tolerance and grain yield in high moisture prone area(s).

References

Gunton, J.L. and Everson, J.P. 1980 Moisture stress in navy beans .I. Effect of withholding irrigation at different stages on growth and yield. Irrig. Sci. 2:49–58.

Haqqani, A. M. and Pandey, R. K. 1994 Response of mung bean to water stress and irrigation at various growth stages and plant densities: II. Yield and

yield components. Trop. Agric. (Trinidad) 71(4): 289–294.

IBPGR 1983 Cowpea descriptors. Rome.

Kamara, C. S. 1976 The effects of excess and deficient soil moisture on the growth and yield of cowpea. In: Tropical Grain Legume Bulletin No. 6. Pp. 4–8.

Minchin, F. R. and Summerfield, R. J. 1976 Symbiotic nitrogen fixation and vegetative growth of cowpea (*Vigna unguiculata* [L.] Walp.) in waterlogged conditions. Plant Soil 25: 113-127.

Nakawuka, C.K. and Adipala, E. 1999 A path coefficient analysis of some yield component interactions in cowpea. African Crop Science Journal 7(4): 327-331.

Okeleye, K., Ariyo, O. J. and Olowe, V. I. 1999 Evaluation of early and medium duration cowpea (*Vigna unguiculata* [L.] Walp.) cultivars for agronomic traits and grain yield. Niger. Agric. J. 30:1–11.

Raje, R. S. and Rao, S. K. 2000 Genetic parameters of variation for yield and its components in mungbean (*Vigna radiata* [L.] Wilc.) over environments. Legume Res. 23(4):211–216.

Srinivasan, G., Pervez, H. Z., Singh, N. N. and Sanchez, C. 2004 Increasing productivity through genetic improvement for tolerance to drought and excess-moisture stress in maize (*Zea mays* L.) In: Veng. S., Craswell, E., Fukai, S. and Fischer, K. (eds.) Water in Agriculture. Canberra, ACIAR Proceedings No 116, 239p.

Summerfield, R. J. and Lawn, R. J. 1987 Tropical grain legume crops: a commentary. Outl. Agric. 16(4): 189–197.

Tyagi, P. C., Kumar, N. and Agarwal, M. C. 2000 Genetic variability and association of component characters for seed yield in cowpea (*Vigna unguiculata* [L.] Walp.) Legume Res. 23(2):92–96.

Umaharan, P. 1990 Genetics of resistance to cowpea severe mosaic virus (Trinidad isolate) and some important agronomic traits in *Vigna unguiculata* [L.] Walp. Ph.D thesis. University of West Indies. St. Augustine, Trinidad and Tobago 379pp.

Table 1. Correlation matrix of different agronomic characters in cowpea genotypes based on combined analysis

	Leaf Area Index	Moisture Tolerance	Days to 50% Flowering	Days to 50% Maturity	Pods/ plant	Pod length (cm)	Pod weight (g)	Seeds/ Pod	Seed weight (g)	Yield (kg/ha)
Plant Ht. (cm)	0.5538*	-0.0858	0.2432	0.0522	0.1701	-0.034	0.1803	0.2871	0.2872	0.2753
Leaf Area Index		-0.3377	0.2128	0.0023	0.3225	-0.0545	0.3798	0.4401	0.3747	0.5255*
Moisture Tolerance			-0.0357	-0.1223	-0.4996*	0.0459	-0.3659	-0.5554	-0.4728	-0.6428*
Days to 50% Flowering				-0.0293	0.3271	0.0564	0.2765	0.5149*	0.5092*	0.2175
Days to 50% Maturity					0.1227	-0.0116	0.0274	0.0419	0.0815	0.3068
Pods perPlants						0.0462	0.6025*	0.6118*	0.6235*	0.5537*
Pod length (cm)							0.0047	0.0195	0.1503	-0.0612
Pod/weight (g)								0.4321	0.3928	0.3601
Seeds per pod									0.8551*	0.6449*
100–Seed weight (g)										0.5042*

* Significant at 5% level respectively