# EFFECT OF SHADE ON THE YIELD AND PRODUCTIVITY OF TWO COWPEA VARIETIES (VIGNA UNGUICULATA)

## (IT90K-277-2 AND IT89KD-288)

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## Abstract

*This experiment was conducted in order to determine the effect of different light intensity on growth, productivity and pod production on some selected varieties of cowpea. In order determine this, two varieties of cowpea which are IT90K-277-2 and IT89KD- 288 plants were evaluated to shade tolerance under four treatment 100% sun, 100% shade, 5 weeks in-out, and 5 weeks out-in. variety 288 showed higher pod weight and number of seeds under 5 weeks in-out of all the treatment; 100% shade induced reduced fodder and grain yield production in both of the varieties. These finding identified variety IT89KD-288 to be more tolerant to shade. These findings could go along way in boasting agricultural yield and productivity in the varieties.*

Keywords- Shade Tolerance, Light Intensity, Yield Productivity, Varieties, Treatment

## Introduction

Cowpea (*Vigna unguiculata*) is an annual crop requiring 12-15 weeks for a complete life cycle depending on the type of variety (early, medium or late maturity). The shoot system forms all parts of the plant above the ground consisting of weak or tender stem acting as a skeletal frame for the growth and support of the other aerial parts. The stem may be determined or intermediate, branches, sub-branches, leaves and peduncles (bearing flowers and pods) develop on them.

Cowpea is of major importance to the livelihood of millions of people in less developed countries of the tropics (Singh *et al.*, 1997).Cowpea is an important food legume. It is importance ranges from its use and food, source of cash and animal feed. It adds fertility to the soil as well as conserves the soil. Cowpea unlike other legumes may be consumed at all stages of its development as green leaves, green leaves, green pods, green peas and dry seeds which is the most popular. Cowpea on average contains 23-25% protein, 559-4447 % search. Thee protein content may probably reach 35%, consisting of 90% water soluble globulins and 10% water soluble albumins. It is therefore, a cheap source of protein and carbohydrates that can be afforded even by the poor among the population (*Singh et al.*, 1997).

Cowpea fixes atmospheric nitrogen into the soil through symbiosis with bacteria (*Bradyrhiobium spp*). The vegetative part also covers the soil maintaining good temperature and moisture levels in the soil as well as preserves it against erosion. Thus, in turn conserves the general fertility and productivity of the soil. These kinds of enormous contributions of cowpea to almost all aspects of man and animal research on cowpea are interesting and helpful.

Cowpea is a warm crop that grow in wide range of environments from 40°N to 30°S (Rache, 1985) through it grows best in the areas where the minimum and maximum temperature are 20°C and 35°C respectively during the growth season. They are especially important in the sub humid and semiarid lowlands of West Africa between latitude of 7° and 14°N (Crawford *et al.*, 1997). The true estimation of the world production is difficult to predict. This is due to the fact that cowpea are grow as multipurpose subsistence crops on small

farm holding and much of the small scale production is neither quantified nor included in cowpea production statistic

The bulk production of cowpea comes from small holding in the semi-arid zones in west Africa, particularly Nigeria (with 77.7% of world production)Burkina Faso (52%) and Senegal (2.1%) yield potential is high averaging 1.5-3 tons/hectare (Hayes and Raheja, 1995). In west Africa about 98% of the cowpea is intercropped (Amon, 1972). In Nigeria, small scale farmers constitute over 90% of the cowpea farmers. The pattern of cropping seen all over is intercropping.

Production has shown that, the human population of the sub-Sahara Africa, will increase rapidly between now and 2025 (Smith et al., 1997). By the year 2020, world population is likely to approach 8 billion. Due to this increase in population, there must be increase in demand for food by the people in developing countries. In view of this, food must be locally produced in huge amount to balance the population food demand ratio (IFPRI, 1995)

## Aims and Objectives

### Aim

The aim of this study is to evaluate selected cowpea varieties for shade tolerance.

### Objectives

1. To assess the influence of shading on the vegetative growth and yield of the selected cowpea varieties
2. To screen varieties for shade tolerance and its effect on yield and productivity of cowpea.
3. To compare the yield and productivity of cowpea varieties, 277-2 and 288 under four treatment.
    - 100% Sunlight
    - 100% Shade
    - 5 weeks in-out
    - 5 weeks out-in
4. Compare the date of flowering, number of branches and length of longest branch in each treatment
5. To find the number of nodes and internodes length in each stand
6. To find the number of stands that survive in each treatment



## Materials and method

The research was carried out at International Institute of t\Tropical Agriculture (IITA) Kano station Nigeria, situated at about 12° 03°N and longitude 08°32°E. The research was carried out in two phases. The first phase was carried out in the 100% sun 5 weeks out-in. The second phase was carried out in 100% shade and 5 weeks in-out. The research was conducted between September and November 2011, in the area of the research (Northern part of Nigeria). Rain starts July with heavier or peak rain in August and September and rain end October.

## Collection and description of seeds

The seeds were collected from the seed store of IITA Kano station. The varieties belong to two different maturing group IT90-277-2 (Medium-maturing variety) and IT89KD-288(late-maturing variety). A brief morphological description of the varieties is stated in table below

**Morphological description of the varieties**

| Variety | Maturing groups | Shape | Colour | Texture | Size | Eye colour |
|---|---|---|---|---|---|---|
| IT90K-277-2 | Medium | Oval | White | Rough | Medium | Brown |
| IT89KD-288 | Late | Kidney | White | Rough | Large | Brown |

**Description of Shade House**

The shade house is a tent made up of rods placed end to end and covered by double layered green sieve-like material making the entire roofing of the house. The shade house was constructed in two different compartments; the roofing is thicker and reduces light reaching the plants below by 80 %. The second compartment and the light by 60%.

**Cleaning of seeds**

The seeds are cleaned from pieces of stones, broken ones and infested ones by sieving and handpicking.

**Soil Preparation**:

The soil preparation includes all treatment given to soil to make it a suitable medium for planting and growing plants. This covers clearing of disturbing obstacles, plant remains, seeds etc. and application of both organic and inorganic manure. The pots were placed into four places for the condition of the experiment. They were watered to the level of moisturizing the soil for planting.

The seeds were planted at the rate of four seeds per hole at the depth of about 2-3cm. 8 seed were planted in each pot. Wooden pegs were used for labeling the pots of respective varieties. The planting was done to cover four respective treatments. (100% Shade, 100% Sun, 5 weeks in-out and 5 weeks out-in. The pots were labelled from the date of planting and samples collection.

**Description of how the pots were arranged and labeled**

| Pots | Rep | Varieties | Treatment |
|---|---|---|---|
| 1 | 1 | IT90K-277-2 | 100% shade |
| 2 | 1 | IT89KD-288 | 100% shade |
| 3 | 2 | IT90K-277-2 | 100% shade |

| | | | |
|---|---|---|---|
| 4 | 2 | IT89KD-288 | 100% shade |
| 5 | 3 | IT90K-277-2 | 100% shade |
| 6 | 3 | IT89KD-288 | 100% shade |
| 7 | 1 | IT90K-277-2 | 100% sun |
| 8 | 1 | IT89KD-288 | 100% sun |
| 9 | 2 | IT90K-277-2 | 100% sun |
| 10 | 2 | IT89KD-288 | 100% sun |
| 11 | 3 | IT90K-277-2 | 100% sun |
| 12 | 3 | IT89KD-288 | 100% sun |
| 13 | 1 | IT90K-277-2 | 5 wks out-in |
| 14 | 1 | IT89KD-288 | 5 wks out-in |
| 15 | 2 | IT90K-277-2 | 5 wks out-in |
| 16 | 2 | IT89KD-288 | 5 wks out-in |
| 17 | 3 | IT90K-277-2 | 5 wks out-in |
| 18 | 3 | IT89KD-288 | 5 wks out-in |
| 19 | 1 | IT90K-277-2 | 5 wks out-in |
| 20 | 1 | IT89KD-288 | 5 wks out-in |
| 21 | 2 | IT90K-277-2 | 5 wks out-in |
| 22 | 2 | IT89KD-288 | 5 wks out-in |
| 23 | 3 | IT90K-277-2 | 5 wks out-in |
| 24 | 3 | IT89KD-288 | 5 wks out-in |



**Data collection**

Data collection was categorized into screen house data collection and field data collection. The screen house data were collected from the shade house.

- **Shade House Data collection**: 24 cowpea plants (12 for each variety labeled) under 100% shade and 5 weeks in-out were labeled with plastic label for data collection. Data collection was taken for pot height, number of pods, seed weight, pod weight, fodder weight, number of branch, node, internode,

Shade length every weeks while that the date of flowering and maturing were taken after 2 days interval.

- **Field Data Collection**: 24 cowpea plants (12 for each variety) under 100% sun and 5 weeks out-in were labeled with plastic label for data collection. Data was taken for pot height, number of branch, node, and internode length every week, while that the date of flowering and maturity were taken after every 2 days interval.

**Detailed Procedures for Data Collection are Listed Below;**

- **Thinning hills and stand count**: four weeks after planting, thinning was done to remove extra plants stand form the hills and keep only the required number of plant stand per hills (i.e. 3 out of 5 plants are remove in each pot). This was done using handpicking. The weakest plant was remove leaving behind the most well tolerated and adapted plant.
- **Pit Height**: 4 weeks after planting the height of the plant from the ground level to the tip of the stem was measured. This was done by using meter rule.
- **Number of Pods**: After maturity, the total number of pods produce by each plant was counted and recorded
- **Number of Seeds**: The pods were broken to release the seeds, and counted the number of seeds.
- **Seed Weight**: The seeds were weighed using an electric weighing balance, this is done by plugging the wire to AC switch on the weighing balance and place a plastic bowl of medium weight on it, press the subtraction key to subtract weight of the bowl, then place the seeds into the bowl and taken reading in grams
- **Pod Weight**: The pod weight was taken as how the seed weight was taken. It is also taken in grams
- **Fodder**: The dried fodder was also weighted using the same procedure as in seeds and pods weight taken.
- **Date of Flowering**: This covered time from the date of cultivation to when the first flower was produced
- **Maturity:** This covered time from the date of planting to date when the pods are ripe.
- **Length of Branch**: this was obtained by measuring using meter rule.
- **Number of Branch**: this was obtained by counting the number of each branch in each stand.
- **Node**: a point at which two branches meet, were also counted
- **Internode length**: Length between one node to another. It was taken by measuring the length between one node to another using a meter rule.

## RESULT AND DISCUSSION

Table 4.0.0 Mean values of seed weight and fodder weight for varieties 277-2 and 288

| Variety | IT89KD-288 | IT90K-277-2 | IT89KD-288 | IT90K-277-2 | IT89KD-288 | IT90K-277-2 |
|---|---|---|---|---|---|---|
| 100% shade | 1.38 | 1.37 | 1.38 | 2.63 | 1.48 | 2.06 |
| 100% sun | 3.77 | 4.13 | 3.95 | 4.74 | 2.17 | 3.46 |
| 5 weeks in-out | 3.18 | 2.39 | 2.79 | 2.82 | 2.83 | 2.82 |
| 5 weeks out-in | 0.36 | 1.16 | 0.76 | 2 | 2.4 | 2.2 |
| Mean | 2.17 | 2.27 | 2.22 | 3.05 | 2.22 | 2.63 |
| LSD (5%) | | | | | | |
| SED | | | | | 0.897 | 0.897 |



Using Anova to check degree of treatment we use formula

t-1 and n-1 where t=2 and n=18

2-1=2

18-2=16

Under 5% point of variance ratio (f) the computed F values are; 2.17, 2.27, 2.22, 3.05, 2.22 and 2.63, which are less than table value which is 4.43 for 277-2 and 288. Indicating no significant difference between weight of the seeds and fodder with respect to the varieties and treatments.

Table 4.0.1 Total Pod Weight at Different Days of Harvest

| Variety & System | | Planting Time | 11-1-2010 | 20-9-2010 | 27-5-2010 | 15-10-2010 | 19-10-2010 | 1-10-2010 | 12-11-2010 |
|---|---|---|---|---|---|---|---|---|---|
| IT90K-277-2 | 1 | 19-07-2010 | 0 | 350.0 | 620.25 | 347.70 | 233.70 | 21.30 | 0 |
| | 2 | 29-07-2010 | 0 | 0 | 408.80 | 88.40 | 67.17 | 0 | 0 |
| IT89KD-288 | 1 | 19-07-2010 | 0 | 0 | 0 | 0 | 0 | 19.0 | 703.25 |
| | 2 | 29-07-2010 | 0 | 0 | 0 | 0 | 0 | 8.55 | 404.20 |



Table 4.0.2 Number of Branch

| **Variety** | **System of Light %** | | |
|---|---|---|---|
| | 100 | 40 | 20 |
| IT90K-277-2 | 4.00 | 2.00 | 2.00 |
| IT89KD-288 | 3.50 | 3.00 | 1.50 |

Table 4.0.3 Mean Pod/Plant produced by the cowpea variety IT90K-277-2 and IT89KD-288 as affected by the sole and intercropping system.

| **Variety** | **System and Intercrop** | **Pod/Plant Sole Crop** |
|---|---|---|
| IT90K-277-2 | 6.50 | 18.50 |
| IT89KD-288 | 10.50 | 9.50 |
| IT90K-277-2 | 8.00 | 14.00 |
| IT89KD-288 | 8.50 | 12.00 |
| | | |
| | | |
| | | |

Table 4.0.4 Mean Pod/Dry Weight (g) produced by the cowpea variety IT90K-277-2 and IT89KD-288 as affected by sole and intercropping system.

| Variety | System and Intercrop | Pod/Dry Weight Sole Crop |
|---|---|---|
| IT90K-277-2 | 152 | 1485 |
| IT89KD-288 | 499 | 514 |
| IT90K-277-2 | 407 | 1455 |
| IT89KD-288 | 413 | 828 |

Table 4.0.5 Mean number of seeds produced by the cowpea varieties as affected by different light intensity.

| Variety | System of Light % | | |
|---|---|---|---|
| | 100 | 40 | 20 |
| IT90K-277-2 | 404 | 102 | 92 |
| IT89KD-288 | 825 | 46 | 6 |

Table 4.0.6 Mean of Plant dry weight (g) produce by cowpea variety IT90K-277-2 and IT89KD-288 as affected by sole and intercropping system.

| Variety | System and Intercrop | Pod/Dry Weight (g) Sole Crop |
|---|---|---|
| IT90K-277-2 | 17.77 | 30.36 |
| IT89KD-288 | 18.13 | 28.41 |
| IT90K-277-2 | 21.44 | 30.17 |
| IT89KD-288 | 25.93 | 32.15 |



**Maturity:** is defined as time at which 90% of pods are ready for harvest. For 277-2 variety maturity was observed first under 5 weeks out-in followed by 100% sun, 5 weeks in-out and 100% shade was the last treatment to have shown maturity between (82-85 days). For variety 288 maturity started under 100% shade, 100% sun, followed by 5 weeks in-out while 5 weeks out-in was the last shown maturity. Thus, the variety maturity in (82-89 days). This conformed to (Singh et al, 1997), who started that; 'Photosensitive medium-maturing like 277-2 variety matured (75-90 days). It is dual purpose (grain + fodder) type for intercropping. Photosensitive-maturing like 288 variety matured (85-120 days) fodder type for intercropping.

**Number of Branch:** For variety 277-2, higher number of branch was observed under 100% Sun, followed by 100% Shade, 5 Weeks in-out, 5 weeks out-in. For variety 288 higher number of branch was observed under 100% sun, followed by 100% shade, 5 weeks in-out and least number of branch was seen in 5 weeks out-in (Table 4.0.2). This conformed to the work of (Singh et al, 1997). The main reason for yield reduction in late planted intercropped cowpea (shaded cowpea) was lack of branch or delayed branch while in the simultaneous planting, the number of branches in intercropped cowpea (shaded cowpea) was 3-4, depending upon the variety which is slightly less than that of mono cropped (full sun condition) which range from 4-6. However the number of branches in intercropped plants 3 weeks later decreased by 0.5-2, while the mono cropped (full sun condition) cowpea still had 4-6 branch per plant. The effect of shade is must serious in the

branch initiation stage, about 3-4 weeks after sowing, which inhibits branching significantly. This showed that manipulating the planting date can also assist in reducing the effect of shade on cowpea plant as seen in 5 weeks out-in and 5 weeks in-out which significantly affected the branch formation with better production under total diameter. This conforms to fagwalawa (2005).

**Long Branch:** For all the varieties, higher value for Long Branch was obtained under 100% for variety 277-2 this followed by 5 weeks out-in. Varieties 288 higher value for Long Branch was obtained under 100% shade while 5 weeks out-in and 5 weeks in-out where found to have the same values. (Table 4.0.2). This confirmed with earlier stated literature on branch as of that number of branch. Moreover longer branch can assist the cowpea to spread more, captures and utilize more light with more production of leaves, flowers, peduncles, pods, and in general with higher fodder and grain yield.

**Node:** For all the varieties highest number of nodes was observed under 100% sun, 277-2 variety same value was obtained under 100% shade, 5 weeks out-in. In variety 288 it was followed by 100% shade and same value was obtained under 5 weeks out-in and 5 weeks in-out. Sunlight is also significant in node production in both varieties as least number was obtained under 5 weeks in-out and 5 weeks out-in. This in turn affect branch formation, fodder and grain yield productivity of the cowpea varieties.

**Internode Length:** In variety 277-2 the longest internode length was observed under 5 weeks in-out, followed by 100% sun, 5 weeks out-in while 100% shade was having lowest value of number of internode. In variety 288 longest internode was observed under 100% sun, followed by 100% shade, 5 weeks in-out and 5 weeks out-in is having lowest value with number of internode length. (Table 4.0.2).

**Number of Pods:** For variety 277-2 higher value was obtained fewer than 100% sun followed by 5 weeks out-in, 100% shade and 5 weeks in-out have shown lower value. (Table 4.0.3) This conformed with (Singh et al, 1997) stated that since leaves which becomes source as well as pods, which become sink, grow on each branch and the main stem, the main final grain yield in non-branched cowpea is significantly reduced shade in the grain filling stage also reduced final seed yield, but the effect is not as pronounce as shading during branch initiation stage. Light is significant in branch and pod since, pods are formed on branch (Table 4.0.3). This finding conformed to fagwalawa (2005). Who turn out that shading the cowpea by the intercropping partner (Cereals) reduced number of pods to be produced by respective cowpea.

**Pods Weight:** In the medium maturing variety (277-2) higher value for pods weight was obtained in under the treatment of 100% sun, followed by 5 weeks in-out, 5 weeks out-in and 100% shade having least value with regards to production. For the late maturing variety (288) higher value for pods weight was obtained under treatment 5 weeks in-out, followed by 100% sun, 100% shade and 5 weeks out-in having least values with regards to production (Table 4.0.3). This conformed to literature of fagwalawa (2005) under intercropping (shade condition). For 277-2 $152_{(g)}$ weight as pod was obtained under light reduction, under sole crop ( full sun condition) $1485_g$ as pod weight was obtained for variety 288 under (shade condition), $499_g$ as pod weight was obtained while (full sun condition) $514_g$ as pod weight was obtained.

**Number of Seeds:** For every variety 277-2 it was obtained that under treatment 100% sun, higher value was obtained, followed by 100% shade, 5 weeks out-in and 5 weeks in-out having least number of seeds. For variety 288 higher number of seeds was observed that under treatment 5 weeks in-out followed by 100% sun, then 100% shade and 5 weeks out-in having least number of seeds (Table. 4.0.3). This also conformed fagwalawa (2005) who find that intercropping by shading affect seeds number in cowpea production.

**Seeds Weight:** For both varieties, higher seeds weight was obtained under treatment of 100% sun, followed by 5 weeks in-out, followed by 5 weeks out-in and 100% shade induced least seeds weight in the same line in the presence determined parameter where shading negatively affect their production in the variety 277-2 and 288.

**Fodder Weight:** For variety 277-2, higher fodder weight was obtained under treatment of 5 weeks out-in, 100% sun and least value was obtained under 100% shade. For variety 288, higher value for fodder weight was obtained under treatment of 100% sun, followed by 5 weeks in-out, 100% shade and 5 weeks out-in treatment is where least value was observed (Table 4.0.3). Since fodder weight comprises weight of stem, branch and leaves. It must be possible to influence by light condition under which cowpea is produced. Little amount of shade is required to improve grain and yield because it possibly reduce rate of transpiration in cowpea plant.

**Pit Height:** For both varieties higher value was obtained under treatment of 100% shade followed by 100% sun, 5 weeks in-out while 5 weeks out-in having least value (Table 4.0.4). This was possible due to etiolation. The long height was due to gibberilic acid. The production of higher height by cowpea as affected by shading is not advantageous toward grain and fodder yield production, Fagwalawa (2005).

**Days of Flowering:** In the 277-2 variety flower production started at 6 weeks in treatment of 5 weeks out-in and 7 weeks at treatment of 5 weeks in-out, 100% sun, for 100% shade treatment flower started at 8 weeks under the influence of 5 weeks in-out, 100% sun, 5 weeks out-in. This indicate that little shading has negative effect as seen in the 100% sun (Table 4.0.1)

**Stand Survival:** For both varieties higher stand survival was obtained under 100% shade treatment, followed by 100% sun, then 5 weeks in-out and 5 weeks out-in having least values. Survival is related to transpiration because in 100% shade there was no transpiration. This indicate that plant at the ecesis stage in their life cycle. This ensures good stand survival and therefore, late planting cowpea to be produced under intercropping will be better for stand survival than simultaneous planting.



## Conclusion

In conclusion, the performance of cowpea varieties under fodder, pod weight, seed weight, number of seeds, number of pods were associated with the formation of Branches and nodes. Both Varieties showed higher performance under treatment 100% sun, least value obtained under 100% shade. This could be with branches and leaf formation as affected by changing light conditions. However, fodders seed weight and pod weight are the most important parameters. Both varieties have same mean number of pods. IT90K- 277-2 have higher mean pod weight and number of seeds while IT89KD-288 have higher mean seed weight and fodder yield.

## Recommendation

It could be recommended that

- Medium maturing variety produced higher grain yield under treatment of 100% sun and 100% shade.
- Late maturing variety produced higher grain and fodder under treatment of 100% sun and 5 weeks in-out.

- Variety IT89K-288 is recommended over variety IT90K-277-2 for intercropping because of its higher grain and fodder yield.

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