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Full-Length Research Paper

Disseminating Earlier Research Findings on Flooding Effects on Yields of an Indigenous Vegetable (*Corchorus olitorius* L) in Ekpoma: Implications for Climate Change in South–South Nigeria

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ABSTRACT: In 1987 and 1988, experiments were done to determine the response of *Corchorus olitorius* to flooded soils at Ambrose Ali University demonstration plot in Ekpoma. The purpose of the study was to determine the influence of floods on *Corchorus olitorius* yields. The study discovered a substantial detrimental reaction of the vegetable crop to floods ($P<0.05$). The typical impacts were low dry weight yields, wilting and yellowing of leaves, which eventually resulted in senescence and plant death. Despite the fact that flooding lowered yields by 91.7%, control plants yielded significantly ($P<0.05$) more dry matter (2.4 g/plant) than flooded plants (0.2 g/plant) at week eight. Similarly, after eight weeks of treatment, the leaf area of flooded plants was $0.76cm^2$/plant, compared to $11.64cm^2$/plant for control plants. As a result of flooding effects, a 93.5% reduction was obtained. The plants' response to flooding confirmed that as the flooding continued, yield decreased dramatically ($P<0.05$). This in-depth understanding of the effects of floods on *Corchorus olitorius* would benefit in the creation of strategies for the production and availability of the leafy vegetable crop in the South – South region in order to improve lives in the face of climate change.

Keywords: Analysis, climate change, *Corchorus olitorius*, crop, flooding, food security, leaf area, livelihoods, poverty, randomly, sampling, vegetable, yield

INTRODUCTION

Corchorus olitorius L, often known as sorrel, Jew's mallow, or jute, is a leafy vegetable belonging to the *Tiliaceae* family. The herbaceous plant is primarily grown and consumed in Southern Nigeria. March or somewhat later is the planting season, and July – September is the harvesting season (Okigbo, 1978). It is also produced in Northern Nigeria, notably in the Savanna zone, where a lengthy wet season lasting from June to November offers sufficient rains and sunlight for the crop's vegetative growth and output.

Corchorus olitorius is locally known in Nigeria as "Ewedu" by the Yoruba in the South West geopolitical zone, "Iyienlolo" in Ishanprovince (South – South geopolitical zone), "Ahihara" by the Igbo in the South East geopolitical zone, and "Malafiya" by the Hausa in the North East geopolitical zone. The leaf is mostly used as a vegetable and is a key ingredient in regional soups.

Corchorus olitorius Leaf is used medicinally to treat cancer, diabetes, and hypertension, among other conditions. Vitamins K and B6 are abundant in this species, as are antioxidants. In traditional medicine, it is used to treat gonorrhea, restless leg syndrome, and to safeguard the health of the eyes. Additionally, it is used to treat internal hemorrhage.

Corchorus olitorius is also used in traditional medicine to treat malaria, typhoid fever, cardiovascular disease, the common cold, and tumors. The species reaches a height of around 3 m and is tolerant of a variety of soil conditions, from loamy to clayey loam. *Corchorus olitorius* Leaves contain between 5% and 6% protein and are a good source of iron, calcium, and phosphorus.

In Nigeria, vegetable production has traditionally taken place on small scales and is frequently combined with arable crops (Omidiji *et al*., 1986). This type of vegetable production is insufficient to meet the needs of the Nigerian populous, particularly during the dry season. The quest to boost vegetable output necessitates, among other things, studying the response of *Corchorus olitorius* to floods and breeding improved cultivars (e.g. flood tolerant types). The purpose of this study was to explore *Corchorus olitorius* response to flooding in order to devise methods for increasing its output and making it marketable in the face of climate change.

MATERIALS AND METHODS

In February 1987 and 1988, seeds of a native variety of *Corchorus olitorius* were collected from a farmer's garden in Ibadan. They were sown in germination trays using garden soil at Ambrose Alli University's experimental farm in Ekpoma (06º 42' N Latitude 06º 08' E Longitude), Edo State, Nigeria. At the Nigerian Institute for Oil Palm Research (NIFOR), soil samples were analyzed for a variety of chemical soil properties (Table 1). The experimental site's mean elevation was 509 meters above sea level. Ekpoma is located in Nigeria's South - South geopolitical zone, within the tropical rainy area. *Corchorus olitorius* seedlings were transplanted into separate 25cm X 15cm polyethylene bags and allowed to harden before being transplanted out in the field. The vegetable crop research was conducted in controlled conditions throughout the dry season of 1987 and 1988 to minimize rains interfering with the treatments. The treatments were as follows: (1) flooded treatment, in which the soil was entirely submerged in water for the duration of the experiment; (2) control treatment, in which daily watering was performed. Seedlings for the flooded condition treatment were planted inside metal containers measuring 204cm X 160cm X 30cm and submerged with water. Water was 2cm above the dirt surface. This level was replenished regularly as needed to re-fill the containers to their flooded capacity. The experiments were conducted in the field using a Completely Randomized Design with four replicates and a spacing of 30cm X 30cm between and within rows (i.e. 111,111 plants^{-ha}). Temperature and relative humidity readings were taken throughout the research periods, and the mean values for the two cropping seasons are given in (Table 2). Sampling for growth and development began two weeks after treatment was applied to allow seedlings to acclimate to the new environment. Following acclimation, and for each subsequent year, weekly sampling was conducted throughout an 8-week period. Five plants of each species were randomly selected and taken from each treatment for growth analysis during each sampling week. Prior to harvesting, the sampled plants in the plastic bags were soaked in a bucket of water for 15 minutes and then gently removed from the bags without losing any roots. The plants were dissected into roots, stems, and leaves and the fresh weights of the various components were determined. The plant parts were dried in an oven at 65^0 degrees Celsius until they reached constant weights and then reweighed to obtain dry weights. The species' reaction was determined using leaf area and the plants' fresh and dried weights. The leaf area was estimated using Hunt's (1978) prediction equation:

$$Y = 1.26 + 0.85X,$$

where Y and X are predictive and calculated (leaf length X leaf width) leaf area respectively.

All data were analyzed by analysis of variance (ANOVA) procedure with SAS Statistical software package (SAS, 1987). Means separations for the effects were obtained by Fisher’s Least Significant Difference (LSD) test as described by Clark (1980). Effects were considered significant in all statistical calculations if *P*-values were less than 0.05 ($p<0.05$).

RESULTS AND DISCUSSION

Corchorus olitorius total dry matter yields are displayed in (Figure 1). Seedlings of the species grown in the control treatment had much more dry matter (2.3g/plant) than seedlings produced in flooded conditions (0.19g/plant). This was expected, given the control plants' availability of optimal water for physiological activities. As Boot *et al*., (1986) noted, the fact that the dry matter of flooded plants decreased clearly shows that flooding affects plant growth rate by impairing cell division and expansion, which are required for growth. The results of the leaf area calculation are shown in (Figure 2). The significantly reduced leaf area observed in flooding treatments (less than 1cm^2/plant) is normal. The control treatment grew a greater leaf area (11.6cm^2/plant) than the flooding treatment, indicating that the control treatment plants produced larger leaves to compensate for the frequent irrigation, which was probably optimal for plant growth. In general, flooded plants fared badly in comparison to

Table 1: Selected chemical properties of soil used for the experiment (0 – 15cm depth).

Chemical Properties	Values
pH (H_2O)	5.15
Organic Carbon (%)	1.32
N (%)	0.08
P ($mg.kg^{-1}$)	4.41
Ca (cmol (+) kg^{-1})	1.00
Mg (cmol (+) kg^{-1})	0.12
K (cmol (+) kg^{-1})	0.05
Na (cmol (+) kg^{-1})	0.29
ECEC (cmol (+) kg^{-1})	2.56
Total acidity (cmol (+) kg^{-1})	1.10

Table 2: mean temperature and relative humidity during the sampling periods*.

Period (Week)	Mean Temperature (^{0} C)	Mean Rel Humidity (%)
1	29.6 ±1.4	72.2 ±3.6
2	31.2 ±0.8	71.0 ±1.9
3	32.6 ±0.6	66.5 ±2.5
4	30.2 ±1.3	72.1 ±1.8
5	28.0 ±1.6	69.0 ±2.4
6	31.6 ±0.9	71.1 ±3.1
7	28.2 ±1.8	68.0 ±0.7
8	27.4 ±1.3	69.5 ±0.9
Mean	30.5 ±1.2	69.9 ±2.1

*Values are Means of two years' data

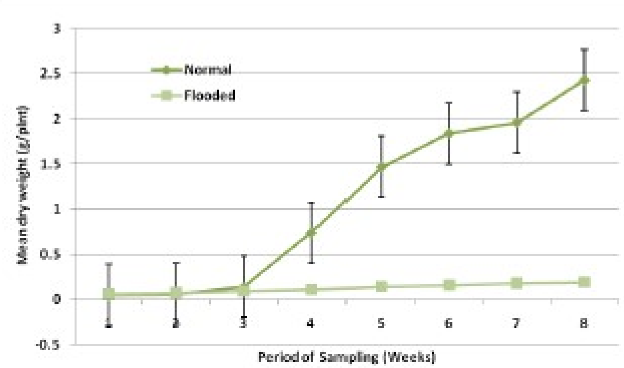

Fig. 1: Mean total dry weight of *Corcorus olitorius* as influenced by flooding

control plants, as measured by dry weight sand lower total leaf area. They, however, survived until week 7, implying that prolonged flooding kills plants and that *Corchorus olitorius* may withstand floods for up to 7 weeks. As expected, plants cultivated in the control treatment grew extensive shoot and root systems and produced huge, green leaves, yielding far more than plants grown in the flooded environment over the two-year study period. This was most likely owing to sufficient water application. Additionally, overwatering plants during the flooding treatment resulted in a 93.5 percent yield reduction. It is very likely that the species' growth rate was determined by the water treatments applied to the plants. However, it has been demonstrated that other elements such as temperature (Fawusi and Ormrod, 1981). Additional experiments with the growth of *Corchorus olitorius* in various locales may assist to confirm this hypothesis.

Significant results from two years of data were consistent with decreased yields and leaf areas obtained from flooded soils compared to the control treatment's regular watered soils. Flooding effects were also visible

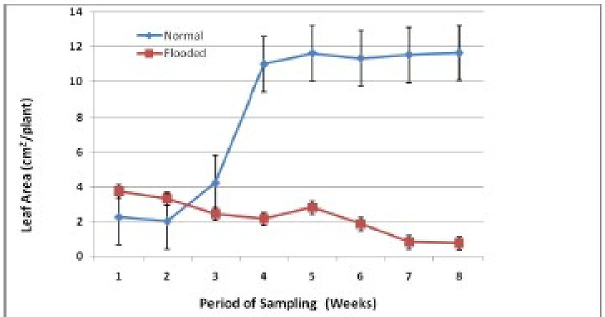

Fig. 2: Total leaf area of *Corcorus olitorius* as influenced by flooding

In the shape of yellowing foliage. According to these observations, the yellowing of the leaves and senescence found in *Corchorus olitorius* under flooded conditions were most likely a response to deleterious impacts, as has been observed in other crops (Davies, 1984; Trought and Drew, 1980). Flooding effects were generally initially noticed during the third week of sampling. Notably, yellow coloration occurred on leaves during the third week of flooding, indicating that metabolic activities were slowed.

Conclusion

The study's findings revealed that *Corchorus olitorius* performed poorly on flooded soils. These findings are especially noteworthy in light of climate change, as nearly all Nigerians rely on vegetables for enhanced health, nutrition, and well-being. Given the stressful conditions imposed on them, the reduced growth rate of *Corchorus olitorius* in flooded settings is predictable. *Corchorus olitorius* ' sensitivity to floods appears to be a depressing aspect of the species. The fact that the impacts of flooding appear to be evident in the plants examined suggests that the capacity of *Corchorus olitorius* to survive flooded circumstances is quite low, which has consequences for food security, poverty, and livelihoods since it may be vulnerable to climate change. Dry matter production and leaf area development indicate that production of *Corchorus olitorius* in Nigeria's South – South geopolitical zone cannot be supported during the peak of rainy season, as farmers would lose around 90% of vegetable yields if grown on flooded and poorly drained soils. *Corchorus olitorius* should be cultivated in dry-land areas of the South – South geopolitical zone with moderate rainfall. Furthermore, it could be grown near the riverside, particularly during the off-season dry time when other vegetable crops are scarce in markets. Off-season vegetable production has a practical advantage in that it improves people's livelihoods by reducing poverty through food security. Climate change research on different vegetable crops is needed to better understand water challenges and their expected effects on vegetable crop output.

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