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A REVIEW OF PRODUCTION CONSTRAINTS CONFRONTING MAIZE CROP IN NORTHERN NIGERIA AND THE WAY FORWARD

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Abstract

Maize production in the Northern parts of Nigeria is characterized with myriads of challenges which often limit large scale production. Chief among these bottlenecks are biotic in nature such as vertebrate and invertebrate pests, disease pathogens, nematode and weeds. Added to those are the abiotic challenges like nutrient deficiencies, environmental issues such as the unfriendly climatic and edaphic factors, agronomic, logistic and social constraints among others. In view of the ever increasing world population especially those that largely depend on maize as one of the staple foods, apart from other industrial uses of the crop, this paper recommends that the way forward is by strictly following the control strategies such as using appropriate cultural, chemical and other methods to combat various production constraints; Pests can be reduced by manipulation of cultural practices, for example, depth of planting, soil and water management, soil amendments ,establishment of plant quarantine laboratories and deployment of more extension workers to the region. Farmers should form cooperative societies to ease access to farm inputs. Also, government should buy excess produce from farmers and provide price incentives for them so as to increase the national food reserve base while reducing the global food crisis at large.

Keywords: *Maize, biotic, abiotic, challenges, control.*

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Introduction

Maize (*Zea may* L.) is the third most important cereal crop in the world, after rice and wheat (IITA, 2009). It *is* an important cereal crop cultivated in all the agro-ecological zones of Nigeria. It was recently reported that about 1.07 billion tonnes of maize was produced from over 160 million hectare worldwide in 2016 (Statista, 2017).

Nigeria is the largest producer of maize in Africa with nearly 8 million tonnes (IITA, 2009). The total land area planted to maize in Nigeria is about 3.3 million hectares with an estimated yield of about 2.2 tonnes per hectare .The grains could be cooked alone or in combination with pulses or milled and boiled as porridge (Yoruba = Eko, Hausa = Kamu, Ibo = Akamu (Ofor *et al*., 2009). Maize is a major source of carbohydrate (3434 Kcal/kg) of metabolic energy (Job, 1993). Maize can be baked, roasted or boiled for consumption. It is used in brewery industries and in compounding livestock feeds (IITA, 2009). Production is mainly by peasant farmers with low hectarage of less than two per farmers, using traditional farming methods in most cases (Ofor *et al*., 2009). Low soil fertility and the limited use of fertilizers especially nitrogen constitute problems of maize production generally in sub-Saharan Africa. Also, periodic drought caused by irregular rainfall distribution reduces maize yields by an average of 15% each year (IITA, 2009; Imoloame and Omolaiye, 2016).

In spite of the various uses of maize in Nigeria and world – wide, production in the Northern part has been greatly constrained by several factors as discussed below:

Crop Protection Challenges

The bottle necks in this category include both the biotic and abiotic factors. Ofor *et al*. (2009) reported the following as major maize protection constraints in the Northern Guinea Savanna of Nigeria:

1. Biotic conditions

Pests and diseases alone constitute a serious setback to food crops produced in this country. Maize is a crop that is highly susceptible to a wide range of pests and diseases (bacterial, fungal, viral, nematode infections) at varying degrees, depending on agro - ecological location.

Pests

Vertebrate Pests

Monkeys, birds, rodents and other wild animals cause serious devastation to maize fields.

They usually cause damages within the hours of 6.00 am and 9.00 am as well as between 4.30 pm and 6.30 pm. Monkeys feed on the immature and matured cobs and thereby reducing crop yield. Control can be effected by setting traps and engaging hunters to kill them, especially on commercial farms. Scare-crows could also be positioned on the farm to ward off the primates.

Rodents such as rats and grass cutters are another category of pests whose destructive

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influence could be unimaginable on maize field in the northern and southern Guinea Savannas parts of Nigeria as they attack newly sown seeds as well as germinating seedlings causing a lot of missing stands and sub optimal plant population. It is advisable that farmers treat their seeds with chemicals materials such as Apron Star, Apron plus and any other seed dressing chemicals before sowing to control rodent attack. Rats attack maize plants both while on the field and during storage. Rats could be controlled with the use of appropriate poisons such as Phostoxin tablets to fumigate the store.

Invertebrate Pests

Various types of arthropod insects, molluscs are in this group of pests on maize plants. These pests feed on maize plants, irrespective of stage of growth; seedling, vegetative, tassling and at reproductive stage. Their main targets could be the roots, stems, leaves, flowers and grains which often lead to serious loss in yields. Termites and mole crickets destroy seeds in the soil thereby creating staggered plant stands. Seeds could be treated with chemicals as well as Dieldren sprays on termites habitat.

Stem borers (*Busseola fusca* and *Sesemia calamistis*); shoot flies (*Atherigona* spp); grasshoppers (*Zonocerus variegatus*) and army worms (*Spodoptera exempta* and *Helicoverpa armigera*) all constitute major insect pests ravaging maize plots in the Northern part of Nigeria. Attack of stem borers is usually more pronounced in late season maize than the early ones. They damage maize crops in the following ways: First, is mechanical injury due to consistent feeding in the stem, weakening it, and thus rendering the stems prone to lodging (stem falling down) and withering (dead heart). Secondly, stem borers may cause characteristic perforations or windows on leaves called ‘fenestrations’ seen when the sheath opens exposing the perforations (NAERLS, 1982). This type of damage reduces the photosynthetic area of the leaves resulting in poor cereal yield, especially during high infestation. Stem borers can be controlled economically by cultural methods. This involves removal and destruction of infested plants and plant residues. Pesticides with contact and systemic action are very effective at the initial stage of infestation to get rid of the larvae before burrowing into the stems.

Army worms, *Spodoptera* spp and *Helicoverpa armigera* occur sporadically but may destroy the crops completely. The larvae are gregarious during outbreak and they feed for about three weeks. Outbreak is associated with alternating wet and dry spells (Misari, 1993 personal communication). These worms cause severe yield reduction on cereals by feeding on developing grains cutting them into smaller bits. Deep ploughing immediately after the season’s harvest exposes the pupae to direct sun-rays resulting in desiccation of the pupae. Chemical control using Uppercott® (Cypermethrin + Dimethoate) gives a good control.

Beside field pests, maize is seriously attacked by storage pests. The most important storage pests include grain weevils (*Sitophilus zea mays*) and *Rhizopertha dominica* for maize crops. In some cases, infestation takes place on the field and continues in the store. Some others are confined to the store while infestation may be by insects already present where the cereal grains had previously been stored or by crops infestation between granaries during storage (Ofor *et al*., 2009)

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For control of storage pests, strict adherence to hygiene in the store as well as provision of air-tight cover is essential. Mixing or storing old grains with new ones during storage should be discouraged. Cereals stored for seed or consumption beyond one month should be fumigated with phostoxin or treated with Actellice.c.

Diseases

Diseases play an important role in the reduction of the potential yield of cereal crops. Agents causing diseases include bacteria, fungi, viruses, nematodes, weeds and nutrient deficiencies. The geographical distribution of cereal diseases in the savanna ecological zones is influenced by temperatures (high/low), moisture (humidity), cultural practices and the type and diversity of germplasm used.

i) Pathogen Problems

In a survey for incidence and severity of diseases in both the northern and southern guinea savanna of Nigeria, Adeoti (1992) reported the occurrence of the common foliar diseases such as the rust, *Turcicum* blight, *Curvularia* leaf spot and *Maydis* blight induced by *Puccinia* spp; *Helminthosporium turcicum*; *Curvularia* spp and *H. maydis* in the order of severity. The 'Pokkhaboeng' disease induced by *Fusarium moniliforme* was also found to be severe in many areas where it occurs (Adeoti, 1992) and the percentage yield loss ranges between 5 and 30%. Other important maize diseases occurring in the savanna ecological zones include smut (*Ustilago maydis*), Downy mildews, Maize leaf fleck and Maize streak. Similarly, some rusts, smuts and blight diseases have been recorded on Sorghum plants. These include common rust (*Puccinia graminis*), Cover smut (*Sphacelotheca sorghii)* and Head smut (*Sporisorium reiliana*).

Control of most fungal, viral and bacterial diseases of maize can be by the use of resistant varieties, seed dressing with Furadan or Apron plus; elimination of alternate host (for rusts); crop rotation, removal and burning of infected plants and spraying with systemic fungicides such as a mixture of Benomyl and Dithane M45, Delsene, Rovrus (for 'Pokkha Boeng' disease) and so on (Ofor *et al*., 2009).

ii) Nematode Problems

Several species of nematode have been reportedly associated with both soil and root of maize in the savanna ecological zones. These species include *Pratylenchus* spp, *Aphelenchoides* spp, *Tylenchus* spp, *Helicotylenchus* spp, *Ditylenchus* spp and *Scutellonema* spp (Chindo, 1991 personal communication). Infected plants fall down from the root level and on examination, the plant roots are shortened, tiller profusely with round stubs at the tips. Control of nematodes is achieved by the use of Furadan 3G and other fumigant nematicides e.g. Ethylene Di-bromide (EDB), Dichloropropenes (Telone) and Dichromo chloropropane (Nemagon). Manufacturer's recommendations should be adhered to for effectiveness (Ofor *et al*., 2009).

iii) Weeds

One of the major problems confronting maize production is weed, which if not properly managed, can cause grain yield loss of 69 - 92% (*Oyewole et al*., 2012). They compete with

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the crops for nutrients, air, light and moisture. The most noxious of these weeds in the Northern Nigerian agro – ecological zones are the parasitic ones particularly striga spp (known as witch weed and "wutawuta" or "kuduji" in Hausa). Some inexpensive control measures including crop rotation, the use of tolerant varieties, generous fertilizer application and hand pulling before flowering can be applied to ensure satisfactory crop yield.

Other 'stubborn' weeds which also reduce maize yield in the savanna include *Rottboellia* spp, *Pennisetum purpureum*, *Cyperus* spp, *Dactylon* spp and some broad leaved plants (compositae). Stomp, Round up, Fusilade and 2, 4-D respectively offer good control of these weeds. Hand weeding is effective but must be timely and repeated twice before the crops mature to ensure economic yield. Since most cereals are shallow-rooted, it is essential to ensure that no mechanical damage is done to the crops roots during hand weeding. In erosion prone sites, earthing up or remolding of ridges may be required to prevent excessive exposure of the roots to the sun.

2. Abiotic Factor

Crop production problems in the savannas can be precipitated by various abiotic factors including climatic, edaphic, nutrient deficiency, agronomic, logistic and social contributors.

Climatic Problems

The savanna consists of the southern and northern Guinea zones, Sudan and Sahel zones. The main characteristics of these ecological zones include poor rainfall (distribution and quantity), high temperatures, humidity, drought, high wind velocity and harmattan, etc. In the last ten years, the onset, distribution and even total amount of rainfall in the savanna zones have been erratic, resulting in crops failure (NAERLS, 1982). Maize crop is more water demanding than sorghum and the uncertainty in rainfall pattern and distribution affected the crop severely. If drought occurs at the time of silking, the result is poor pollination and serious loss of grains (Ofor *et al*., 2009). The Sahel zone (Katsina, Sokoto, Maiduguri, Kano, Potiskum, Nguru etc.) are particularly vulnerable to this problem where average maize yield on rainfed crop is below 400kg/ha as compared to national average ranging between 1000kg/ha and 2500kg/ha.

The problem of erratic rainfall and drought can be solved by constructing more dams for irrigation. Breeding of drought tolerant /resistant varieties of maize and sorghum as well as closer rows may reduce soil moisture loss at the end of the season (Ofor *et al*., 2009).

Edaphic Factors

Soils in the savanna parts of the country consist of sandy loam, clayey-loam and loess (wind deposited sand). Organic matter contents are generally low (< 0.5%) and plant nutrients are critically low. In some places, soil water availability is very critical and in some others water logging constitutes a night mare to farmers. Soils of the savanna are generally alkaline in nature but in some cases, soils with low pH values have been reported (UAC Agro, 1989 unpublished). Erosion due to wind and running water also create problems in some localities. These edaphic factors constitute an impediment to crop production in the savannas and can be remedied by various soil amelioration processes. These include application of cow dung,

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poultry droppings, farm yard manure, and leaf dropping of shelter trees (to improve the organic matter content and improve the physical properties of soil). Wind erosion can be checked by establishment of shelter belts in wind prone areas (Kano, Sokoto, Daura, etc.). Erosion due to running water (flood) can be checked through construction of appropriate drainage systems; embankments and levees; encouraging vegetation cover in susceptible areas. Soils with low pH can be reclaimed through liming to improve its nutrient availability to the crops (Ofor *et al*., 2009).

Nutrient Deficiencies

Ofor *et al*. (2009) reported that maize is a heavy feeder crop than many other cereals (rice, millet and wheat). It requires both the major nutrients (N, P and K) and the secondary nutrients (S, Mg, Ca, B, Fe, Cl, Cu etc.) in adequate quantity. Deficiencies of vital nutrients cause yield reductions through poor plant development (IITA, 2009).

The Federal government should improve on fertilizer subsidy in order to encourage farmers to produce more maize in this region (Ofor *et al*., 2009). Also, farmers should form cooperative societies to ease access to fertilizer and other farm inputs.

Agronomic Factors

The following are some agronomic or cultural practices that affect maize production in Northern Nigeria as reported by Ofor *et al*. (2009):

(1) Planting depth affects incidence of pests and diseases. Deep planting causes the seed to rot while shallow planting subjects the seed to predation by birds, rodents, termites; and may weaken the roots of seedlings. Solution to this problem is to plant at the recommended depth, usually between 2.5cm and 4.5cm on ridges or flat.

(2) Seed Bed Preparation - Poorly prepared seed bed encourages shallow rooting, poor seed establishment, lodging and wilt due to soil water unavailability to plants. Good seed bed preparation is therefore essential to ensure good crop establishment and high yield. Deep plowing, harrowing and ridging facilitate water penetration, exposes eggs and diapausing pupae of pests to desiccation by the sun and ensures weed and erosion control in the field.

(3) Removal of crop residue - Maize stalks left over on the farm after harvest is a source of pest and disease attack next planting season. Their removal and burning will ensure protection of crops from this source of infestation. Guinea corn stalk used for fencing or building should be properly dried in the sun before use.

(4) Timeliness is very important in crop protection programmes; a little delay can jeopardize efforts and render completely unprofitable all that have been incorporated into the farming enterprise. For instance, stem borer is an insect pest of economic importance on cereal crops. Larvae of these insects are found in the whorls feeding on the young unexpanded leaves and later bore into the stem. Control programme for these insect pests should be directed at the larvae while feeding in the whorls. If spraying is delayed and the larvae have bored into the stem, the use of contact insecticides to control the insects at this stage is no longer feasible (Amatobi *et al*., 1988).

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(5) Similarly, some insect pests that attack produce in storage usually commence infestation while still in the field. These fields to storage pests (e.g. *Sitophilus* spp on maize and sorghum) may cause extensive damage to stored produce if harvesting is delayed on the field. Timely harvesting of these crops is recommended to avoid further yield losses during storage.

(6) Pesticides are chemical formulations for the prevention and control of crop pests and diseases. Pesticides include herbicides, insecticides, fungicides, bactericides, nematicides, various protectants and growth regulators. Certainly, chemical weed control allows for more prompt and efficient control of annual and perennial weeds if used appropriately than cultural and mechanical methods. However, a major disadvantage in the use of herbicides in the tropic is that they rarely give a season long control of late emerging weeds in crops (Lagoke, 1993). Similarly, improper and excessive use of herbicides could lead to problems such as persistence in soil, resistance of weeds to them and underground water pollution (Farhood *et al.,* 2014). Even when the correct pesticide is purchased by the farmer, the pesticide may not be effective due to staleness, late application after significant damage has been done to the crop; poor follow up of the recommended application schedule, incorrect method of application, sole reliance on pesticides in situations where other methods are more effective and fear of toxic effects on crops and man (Srivastava, 1974). Another constraint to pesticide use in the northern savanna is the lack of large amount of water required for conventional application. Even when water is available, cost of labour in carrying and applying large quantities of water can be quite high. The above problems can be solved by training and posting more extension workers to the villages to assist farmers solve their crop protection problems. Water shortages can be checked by digging wells or sinking bore-holes in the farms and by formulation of more ultra low volume (ULV) pesticides with hand sprayers.

(7) Use of Resistant varieties - Farmers in the northern savanna seldom plant improved resistant varieties of maize due to its high demand for fertilizers and good management practices before high yield is guaranteed. Solution to this problem lies in effective extension services and mass literacy campaign to change farmers' orientation.

Logistic and Social Problems

There are inadequate extension services to cater for the needs of the teaming population of maize farmers in the Northern parts of Nigeria. Also, a major social problem in crop production and protection in the Northern Nigeria is the inadequate price incentives to farmers particularly when there is natural disaster. Price incentive is necessary to guarantee farmers good reward for their efforts. Also, excess produce should be purchased by the governments and stored at strategic grain reserves units. All these would encourage farmers to produce more to feed the teeming population in the country (Amatobi, 1984).

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CONCLUSION

A number of crop production and protection challenges limiting maize production in the Northern part of Nigeria have been identified, which are largely the unfavourable biotic and abiotic factors. The way forward is by strictly following the control strategies such as using appropriate cultural, chemical and other methods to combat various production constraints; Pests can be reduced by manipulation of cultural practices, for example, depth of planting, soil and water management, soil amendments, establishment of plant quarantine laboratories and deployment of more extension workers to the region. Farmers should form cooperative societies to ease access to farm inputs. Also, government should buy excess produce from farmers and provide price incentives for them so as to increase the national food reserve base while reducing the global food crisis at large.

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