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EFFECTS OF CLIMATE ON PESTS OUTBREAK IN THE SUB-HUMID REGION OF NIGERIA: A CASE STUDY OF KABBA, KOGI STATE

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ABSTRACT

Climatic pattern associated with both outbreak and life cycle of zonocerus grasshopper were examined in this research work. Deterministic approach was used to solicit for the data required. This data collection methodology assumes that pest outbreak is a function of the prevailing climate. The critical weather elements associated with outbreak were analysed by isolating the onset, development and cessation of the pest based on the developmental stages of its life cycle. The result shows that high rainfall (amount and frequency) and high temperature favour egg laying development while low rainfall (amount and frequency) encourages the severity of adult zonocerus grasshopper. Thus a number of implications on agricultural products have been observed to include:Severe infestation of grasshopper hence, severe crops devastation during the dry years; reduction in quality and quantity of these farm products and that; crops are less vulnerable to pest attack during wet year. Hence, emphasis on farming system should be on phases taking cognisance of those crops that thrive best in the wet season.

INTRODUCTION

Agro-climatology aims at improving sensible use of land, producing surplus food for man and stopping the irreversible abuse of land resources by examining the inter-relationships existing between agriculture and climate. Thus, Olaniran (1981) stressed the need for renewed efforts in agro-climatology with emphasis on: analysis of agriculture-climate relationship; analysis of harvest damage and loss; and evaluation of the present land use and the potential land use. A study of a weather pattern relationship especially as demonstrated in this study is thus in line with the objective outlined in (b) above. Also as noted above, it constitutes the study of the second-order relationship between agriculture climate. This relationship explains the indirect effect of weather on agriculture.

The Indirect Effects of Weather on Agriculture

The adverse effects of weather is manifested on agriculture directly through phenomena such as drought, flood, snowfall and hail stones which are termed as primary effects of weather. On the other hand, the indirect effect otherwise known as secondary effect is seen through the incidence and intensity of pests and diseases of both plant and animal. A number of researchers have brought into focus the negative impact of pests and diseases on agriculture. These negative roles played by pests and diseases in agriculture occur on a global scale. Though, the influence is world wide, losses are highest in the tropics (Voudeowi and Service, 1983). For instance, a tremendous potential for more animal production in the tropics occur than what obtains in the temperate as noted by Starr (1986). However, great disparity exists when the two are compared due to the tropical weather which makes the animal of the tropics more susceptible to various diseases. The rate of diseases or pests transmission is so fast that it was suggested that there is the need to know the role which climate and weather plays in animal's health so that prediction of animal production will be accurate and effective. Starr (1981, 1983, 1984) examined the negative effects of weather on animal production. He observed temperature, wind and rainfall as the climatic factors which are critical for lamb survival.

On crop production, the indirect effects of weather can be associated with insects and plant diseases.

Chadha (1974), Olunloyo and Adeniyi (1974), Pinnochet and Ventura (1977), Ito et al (1979), Adelana and Simons (1980), Caswell (1981), Oluwadare and Akande (1985) and Jirgi (1990) examined purely the indirect influence of weather on crop yield. Chadha (1974) in his field investigation based on the incidence of Antigastra in sesame crop and climatic condition obtained a positive correlation conditions between antigrastra infestation and sunshine duration, high maximum temperature but negative with high and continuous rainfall. Olunloyo and Adeniyi (1974) singled out rainfall as a catalyst to high infestation of Roselle root and stem root which is a seasonal diseases of two varieties of Hibiscus in the western part of Nigeria. Olunloyo (1979) established a relationship between relative humidity, moisture content of kolanuts in equilibrium with the ambient humidity and rate of mould development on the stored kolanut. Caswell (1981) examined the spatio-temporal variations of the damage done to cowpea by pest in Nigeria.

On the basis of time scale Caswell (1981) noted a steady rise in the level of damage done to cow pea from December - March in Zaria when about 35% of seeds were damaged. It remained on this level until August when it began to fall till the month of December. In space, a decline in the average level of damage from North to South was observed. A drastic fall from 40% was recorded in the far North to 30% and finally 15% in the South was reported. Oluwadare and Akande (1985) identified rodents and granivorous birds among others as pests to rice.

Adejuwon (1983) described the damage done to both crops and animals by pests and diseases as limiting socio-economic development in Nigeria. Jirgi (1990) attributed the destruction of crops worth ₦225 million to pests of different kinds in the country. Zonocerus variegatus grasshoper like any other pests is responsible for low yield of both food and cash crops in the developing countries. Hoarse (1968), Bernays et al (1977) noted that zonocerus feeds on cassava leaves, lettuce and cowpea leaves. However, Youdeowei and Service (1983) reported that zonocerus does not only defoliate cassava plants, but, also scrape the bark of cassava plants after complete defoliation of the plants. Aina (1984) observed that it feeds on all green plants hence, went further by describing zonocerus grasshoper as a general feeder. There is therefore the need to search for responses to the problem of pests based on the above problems.

This study therefore attempts the analysis of weather pattern associated with the incidence and development of variegates grasshoper pest in Kabba area of Kogi State. Specifically, the study tries to identify the pattern of spread of pest and its effects on crops production in the study area.

THE STUDY AREA

The study area is located on latitutde 07° 50'N of Equator and longitude 06°04'E of Greenwich Meridian and at an elevation of 427m above mean sea level. Kabba has tropical dry and wet climate with uniform high air and soil temperatures throughout the year but shows strong seasonal variations in rainfall, relative humidity and sunshine duration. The climate is characterised by winds from two opposing directions, the moist equatorial maritime air mass and the dry tropical continental air mass. Kabbba comes under the influence of south-west wind during rainy season and North-East wind during dry season. Wind velocity reaches its peak in April with an average speed of 48km/h. Much of the vegetation is covered by secondary forest otherwise termed derived savanna. Morrison and Spence (1989) identified weather conditions as important factors in determining the magnitude of pest and pathogen infestations of crops.

In the study area, the outbreak of grasshoper since 1976 has been a continuous exercise. In 1976, 1978, 1986 and 1982 the outbreak of grasshopper occured twice while in other years till 1989 it occured once. This is alarming because of their disastrous effect on agricultural yields in Kabba.

METHODOLOGY AND DATA COLLECTION

Different approaches have been employed in studying the relationship between pests and climate. These include empirical investigation of pest-climate-crop relationship (Morrison and Spence (1989) and climate (Alexander 1964). However, in this study, deterministic approach was used. This method assumes that pest outbreak is a function of the prevailing climate. In view of the above assumption, the onset, development and ceassation of the pests are collected based on the developmental stages of life cycle of Grasshopper. Average and extreme conditions of climatic variables such as air temperature, rainfall, relative humidity, wind, sunshine duration duration and soil temperature are collected over 15 years duration for the study.

Climatic data were collected from the meteorological station located at the college of Agriculture farm centre Kabba over a period of fourteen years (1976-1989) while pest outbreak data were sourced from the records of the Kwara State Agricultural Development Project, Ilorin. The data collected on grasshopper were divided into two on the basis of severity of grasshopper outbreaks - severe and moderate years. Similarly, the life cycle of the grasshopper of egg, larva and adult stages were also used to analyse data collected on the nature of pest outbreak.

The data collected from these sources include rainfall, relative humidity, air temperature (maximum and minimum) and soil temperature at 10cm depth because variegatus grasshopppers do not dig beyond this depth for egg laying and hatching. The nature of pest outbreak was ranked into two classes. Years with more than one pest outbreak were described as severe while years with just one occurence were described as Mild. Also month which experience the outbreak of pest was noted so as to investigate the weather condition preceeding the outbreak, prevailing during the outbreak and shortly alter the outbreak.

RESULTS AND DISCUSSION

It was discovered that the following climatic conditions are favourable to the growth of grasshopper in Kabba: high air and high soil temperatures and high rainfall are responsible for maximum egg laying exercise, low rainfall, high air temperatures favour nmphs invasion, and low rainfall encourages adult infestation. A comparison of the results shows that all the years of severe outbreaks experienced below average rainfall.

Egg Laying Stage

In the study area, egg laying of the zonocerus variegatus occurs between the month of April and June at Kabba. Rainfall and relative humidity were fairly high for the two episodes (Mild and severe) but with some variations while rainfall mean was 82.46mm for mild year, a considerable rise of 146.06mm was observed for severe year. For mild and severe year relative humidity stands at 62.58% and 78.71% respectively. Rainfall frequency is also higher for severe years (9.75mm) but lower for mild year. Both air and soil temperatures shows little variations and are high throughout the two episodes. Sunshine duration for mild and severe years were 6.10 and 5.5 hours respectively. In general, it appears that high air and high rainfall frequency and high soil temperatures encourage egg laying.

Larva Stage

The period of the year that witnesses hatching of grasshopper eggs include the months of July, August and September. Three main climatic factors critical for egg hatching to larva as recognised by Pierre (1958) include soil temperature, air temperature and water. Average climatic parameters considered for mild and severe years showed mark variation from climatic situation experienced during egg laying period. Some climatic parameters which enhanced egg laying appear to inhibit larva development.

Severe years recorded the lowest monthly rainfall amount of 204.97mm (Table 1.3a). The attack was mild when monthly rainfall amount was higher. Fluctuation in rainfall frequency was high (15.4) compared to 13.42 during severe year. Air temperature was high throughout the two episodes. Maximum temperatures for mild and severe years were 28.41°C and 28.8°C respectively. However, slight variation was observed in minimum temperatures. Severe year recorded 20.27°C and mild year 20.33°C. SOil temperature was uniformly high throughout the two episodes (23.62°C for severe and 24.09°C for mild years). Sunshine duration for both were almost the same 5.41 for (severe and 5.236 hours for mild year. Suffice to remark that, low rainfall amount, low rainfall frequency, high air and soil temperatures account for the severity of nymphs.

Adult Stage

The duration of the period identified as adult stage differs according to different episodes. For severe years, adult grasshopper is a common sight as from the month of October and persist till March of the following year. However for a mild episode adult grasshopper appear in January and lasts till March. Weather pattern during this stage for the two episodes showed some marked similarities and differences from the last two ontogenetic stages. Rainfall is low generally during these periods. Periods of severe infestation also record lower rainfall amount of 26.26mm and lower rainfall frequency of 3.09 while mild year recorded high rainfall amount of 46.94mm and higher rainfall frequency of 4.08. Relative humidity of 62.11% was recorded for mild year while air humidity, for severe year was 65.77%. Air temperature was high through out the two episodes. However, air temperature was higher during adult stage than during both egg laying and larva stages. Mild and severe years recorded 31.16°C and 30.95°C respectively (Ref. table 1).

Table 1: *Mean Climatic Conditions during the Life Stages of Grasshopper in Kabba.*

	Egg Laying Stage		*Larva Stage*		*Adult Stage*	
Mean climate conditions (1.4b)	*Severe Out-break (1.2)*	*Mild Outbreak (1.2b)*	*Severe Out-break (1.3a)*	*Mild Outbreak (1.3b)*	*Severe Out-break (1.4a)*	*Mild Out-break*
Rainfall (mm)	146.06	82.46	204.97	242.3	26.1	46.94
Air Maximum Temperature (oC)	30.42	31.27	28.8	28.41	33.8	31.16
Air Minimum Temperature (oC)	21.06	20.55	20.27	20.33	23.9	19.14
Relative Humidity (%)	78.71	62.58	84.85	73.98	74.0	62.11
Sunshire Duration (Hr)	5.5	6.10	5.41	5.26	5.0	5.4
Soil Temperature (oC)	28.39	27.7	23.62	24.09	29.4	24.64
Rainfall Freq.	9.75	7.5	15.5	15.4	4.0	4.08

Of all the climatic parameters considered rainfall appears to be the most important variable and is a critical parameter in determining severity in each ontogenetic stage. Variability in amount and its frequency play a major role in explaining zonocerus variegatus intensity at a particular point in time. In general, for maximum egg laying exercise to occur, high rainfall, of about 146mm, high relative humidity of about 80%, high air temperature of about 30°C and high soil temperature of about 29°C are required. On the other hand, low rainfall amount, of 26mm, low rainfall frrquency of 3.09 and low relative humidity of 62.11% favour adults survival. It appears to a certain extent that nmphs can cope with any of the above situations. Although air and soil temperature were high throughout the ontogenetic stages, highest value of 31.27°C was observed during egg laying and adult stages while highest soil temperature of 28.31°C was witnessed during the egg laying period.

SUMMARY AND PLANNING IMPLICATIONS

The research work focused on the influence of climate on the life cycle of grasshopper. The influence of climate for each stage of the life cycles is greater in dry years than in wet year. The principal result of this study indicates that drought encourages outbreak of zonocerus grasshopper. Thus whenever drought is expected cultural preparations such as scaring method and planting early in such a way that crops develop and mature within the wet period of the year should be encouraged so as to reduce the outbreak of grasshopper. Sometimes planting of new breed crops should be encouraged to destabilise the growth of grasshopper. The results call for a further systematic documentation and experimentation of the relationship between pests and climate in the area for posterity. This is in the hope of alleviating the negative roles played by grasshopper on agriculture in the nearest future.

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