PDF - INFLUENCE OF COMPACTION AND MOISTURE REGIME ON PERFORMANCE OF RHIZOBIUM-INOCULATED SOYBEAN (GLYCINE MAX L. MERILL) IN AN ALFISOL OF NORTHERN GUINEA SAVANNA OF NIGERIA - researchcub.infoCHAPTER ONE

1.0 INTRODUCTION

Soybean (Glycine max L.) is the most important and mostwidely grown of the grain legumes worldwide (Giller and Wilson, 1991) of greatnutritional value and enormous uses. It is a source of protein in human food,animal feed and industrial products. Proximate composition of soybean is 40%protein, 20-21 % fat (oil), 32-35% carbohydrate, 5% ash (mineral) and 3% fibre(Anonymous, 2011). Soybean is native to East Asia and first introduced toAfrica in late 1800s (Shurtleff and Aoyagi, 2007), and to Nigeria in the year1904 (Ezedimma, 1964). Nigeria is the largest soybean producing country inSub-Saharan Africa. A total of about 661,000 ha of soybean were harvested inWest Africa out of 99,501,101 ha cultivated worldwide. Nigeria accounts for 95%and the remaining 5% in the rest of the West African countries (FAO, 2009).

Soybean is one of the major legume crops cultivated innorthern Guinea Savannah (NGS) of Nigeria. Although its production among legumesrequires assimilation of large quantity of nitrogen for maximum yield, soils ofthis region are poor in nutrient status, especially total N (Machido et al.,2011; Laditi et al., 2012). The situation is further worsened by nutrientdepletion by crops and other related processes, such as leaching,denitrification, volatilization and removal of crop residues for alternativeuses (Yakubu et al., 2010). Among the means available to supply and improve soilnitrogen status, fertilizer plays an important role. However, the productionand use of chemical nitrogen fertilizers is historically influenced bychanging; and often interrelated factors such as increasing populations andeconomic growth, agricultural production, prices, and government policies (FAO,2011). Their production requires a great consumption of fossil fuels (1-2 %global fossil fuel) and is subjected to constant variations in prices (Vieiraet al., 2010). The comparison, in terms of economic and ecological costs,between chemical and biological nitrogen fertilizers shows that biologicalnitrogen fertilizers represents an economic, sustainable and environmentalfriendly resource to guarantee the nitrogen requirement of an agro-ecosystem.It has been reported that significant portion of soybean N (up to 80%)(Salvagiotti, 2008) is derived from biological nitrogen fixation (BNF) whengrown in association with effective and compatible soil bacteria known asBradyrhizobium (Chianu et al., 2009). Although, yields of legumes can beimproved by additionof appropriate rhizobium inoculants, this can only besustained and assured under suitable soil environment. Suitability of the soilenvironment depends soil management practices. An important soil managementpractice that influences soil quality is tillage (Mahdi and Hanna, 2004). Thetraditional tillage practice in this zone involves manual hoe ridging andweeding. These are done with no special attention to conservation measuresagainst soil nutrient depletion (mining), soil erosion and runoff (Kirchhof andOdunze, 2003) and many changes in soil physical qualities.

However, the introduction of agricultural machinery into thecountry has led to increased level of mechanized farming with the aim to easeand hasten the processes of cultivation. Heavy machines are extensively used inland cultivation, from sowing to harvesting. This result in varying degrees ofsoil compaction that causes profound changes in soil structure. Soil structureis important and must not be damaged because it determines the ability of soilto hold and conduct water, nutrients, and air necessary for plant rootactivity. Compaction affects not only the physical, chemical and hydraulicproperties of the soil, but also seed germination, root growth, waterutilization, nutrient uptake by crop (Sataranayana and Ghildyal, 1970) andactivities of soil microorganisms. It had been reported that the use ofmachineries and fertilizers may not preserve productivity if significant soildeterioration occurs (Lal, 1979).

Therefore, there is the need to develop better soilmanagement practices that prevent or reduce the effect of soil compaction onsoils and crops. This mainly involves management measures aimed at controllingtraffic on soils during and after cultivation. This may also include adoption ofagronomic practices that would improve soil physical condition such asconservation farming approaches based on no-tillage or minimum tillage.No-tillage practice refers to zero tillage (zero disturbances on the soil) withdirect application of seeds into the soil that aims at 100% ground cover withno plow or disk used. Even with the best soil physical quality, cropproductivity depends to a great extent on availability of soil moisture.

Moisture deficiency is one of the most importantenvironmental factors affecting agricultural productivity around the world andmay result in considerable yield reductions if unchecked. The need to producemore food with less water poses vast challenges to reassign existing watersupplies, encourage more efficient use and promote natural resource protection(Hussain et al., 2007). One of the water conserving irrigation schedulingtechniques is deficit irrigation which provides a means of reducing waterconsumption while minimizing adverse effects on yield and the environment(Ghinassi and Trucchi, 2001; Kirda, 2002; Panda et al., 2003). The mainobjective of deficit irrigation is to increase the water use efficiency (WUE)of a crop by eliminating irrigations that have little impact on yield. Theresulting yield reduction may be small compared with the benefits gainedthrough diverting the saved water to irrigate other crops for which water wouldnormally be insufficient under traditional irrigation practices. This objectivewill be achieved through improvements in agronomic practice, cultivation ofsuperior legume varieties, and increased efficiency of the nitrogen-fixingprocess itself by better management of the symbiotic relationship between thelegumes and bacteria.

1.1 Problem Statement:

Food production capacity is faced with an ever-growingnumber of challenges, including a world population expected to grow to nearly 9billion by 2050 and a falling ratio of arable land to population (PDESAUNS,2007). Crop production in the northern Guinea Savanna of Nigerian is increasingin scope and intensity and crops are commonly grown under rainfed conditions.The major crops include maize, sorghum, rice, cowpea, groundnut, cotton, andsoybean. However, the soils are increasingly being degraded by poor managementpractices. The soils consequently do not contain sufficient plant nutrients tosupport vigorous crop growth and high yield (Kowal 1972; Jones and Wild, 1975).There is need to ensure adequate food production using sustainabletechnologies. This may include application of chemical nitrogen fertilizers.However, chemical nitrogen fertilization is associated with environmentalproblems such as watershed contamination by nitrogen leaching, volatilizationand de-nitrification and all these can be source of environmental pollution(Herridge et al., 2008). Rhizobium inoculants are widely used in agriculturefor production as to improve soil fertility because of their ability to fixatmospheric nitrogen in association with legume crops. The products areenvironmentally friendly and cheaper source of nitrogen.

Successful inoculation and establishment of effectivelegume-rhizobium symbiosis can only be achieved in the presence of favourablesoil physical conditions such as soil porosity, moderate bulk density, moisturecontent and soil temperature which are all influenced by soil tillage systems.Effects of these soil physical properties and processes can be expressed aschanges of soil microbiological activity, soil respiration and consequentlychanges in plant growth and development

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