Evaluation of Proportionate Combinations of Indigenous Rice Bran and Mineral Fertilizer for Improved Performance of Tomato (*Lycopersicon lycopersicum)* Under Low Fertile Soil conditions

ABSTRACT

Under tropical soil conditions, where soils are mostly marginal and deliberate fallowing of farmlands is very uncommon, integration of two or more different fertilizer materials, at pre-determined proportions, may be beneficial to soil quality improvement and enhanced crop productivity. Field experiment was carried out in the year 2015, at the Teaching and Research Farms, Ladoke Akintola University of Technology, Ogbomoso, Nigeria to determine the effect of organic and inorganic N-fertilizer materials on performance of tomato, under low fertile soil conditions. Six treatments introduced were: T0 (No fertilizer application), T1 (100% N.P.K), T2 (75% N.P.K + 25% Rice bran), T3 (50% N.P.K +50% Rice bran), T4 (25% N.P.K+ 75% Rice bran) and T5 (100% Rice bran) arranged in randomized complete block design (RCBD), replicated three times. Data collected were collected on growth and yield parameters, and analysed using Analysis of variance (ANOVA). Means were separated using Duncan multiple range test (DMRT) at 5% level of probability. All fertilizer materials applied significantly enhanced tomato growth, yields and nutrient uptakes, compared to the control. Sole application of 100% NPK and Rice bran significantly improved fruit yield by 831.5% and 597.1% respectively, while their combinations significantly enhanced tomato fruit yield ranging from 819% to 1127%. These indicate that combined application of organic and inorganic fertilizers is better than sole application. Also, significantly prolonged leaf production was observed (which equally promoted prolonged flowering and fruiting), in tomato plants which received Rice bran applications at 50% level and above. Therefore, since there is an increasing awareness nowadays, on the environment friendly benefits of applying organic materials to farmlands, application of either 75% or 100% NPK fertilizer should be totally discouraged. Hence, 75% Rice Bran + 25% NPK could be recommended or alternatively 50% Rice Bran + 50% NPK, for tomato production in the study area. This will improve soil organic matter content, reduce soil chemical fertilizer loads or inputs and alleviate the residual effects of synthetic fertilizers, for improved soil quality and tomato production, in the study area.

Keywords: Tomato, Proportionate Combinations, Indigenous Rice Bran, Mineral Fertilizer, Soil Fertility and Crop Performance.

1.0. INTRODUCTION

Tomato (*Lycopersicon lycopersicum* L. Mill) is an arable fruit vegetable. It belongs to the family solanaceae. Tomato ranks first amongst the common fruit vegetable crops in Nigeria and dominates the largest of the estimated vegetable crops production areas (Rawshan, 1996). Tomatoes are normally propagated either by seeds, sown directly on the

field or by transplanting of seedlings obtained from the nursery. Although tomato is grown throughout the year, the best period for tomato production in Nigerian Savanna is the dry season, when the weather is cooler and the incidence of pests and diseases is minimal (Anonymous, 2000). Many varieties are now widely grown, sometimes in greenhouses in cooler climates. The plants typically grow up to 1-3 meters in height and have a weak stem that often sprawls over the ground and vines over other plants. More so, the dietary significance as well as the considerable versatility of tomato cannot be over-emphasized. The fruit is a berry type, and ripe one could be eaten fresh or raw (e.g. salad), when cooked or processed, as in soup, stew, ketchup, paste, juice, powdered or canned tomatoes etc. (Adebooye *et al.,* 2006; Babajide and Salami, 2012). Tomatoes have been reported to be important sources of nutrient anti-oxidants such as lycopene and vitamin C in human diet (Clinton, 1998). Lycopene, the most important anti-oxidant has been linked with reduced risk of prostrate and other forms of cancer as well as heat diseases (Barber and Barber, 2002). The fruits are highly perishable and are commonly sliced and dried (due to poor storage facilities), to await future uses or sales (Babajide *et al.,* 2008).

Rice bran is obtained from rice processing (i.e. de-hulling). Rice bran is also referred to rice husk or rice hull. It is thereby regarded as a waste material. Although it is used for economic feeding of livestock hence, many tonnes of this material are found wastefully deposited in many rice processing villages in Nigeria. However, if properly managed, rice bran is a potential fertilizer material, which is relatively high in Nitrogen, and could be used as a sole soil amendment or for organic fortification of chemical fertilizer materials, suitable for arable crop production. Nitrogen is an essential nutrient element required in photosynthesis and was also reported to support luxuriant and vigorous plant growth (Anonymous, 2000; Akanbi, 2002; Babajide *et al.,* 2012). Inappropriate use of fertilizers greatly reduces fertilizer efficiency and imposes negative effects on soil productivity (Tejada

et al., 2005; Babajide, 2010). Both organic and inorganic fertilizers should be applied to match nutrient needs of crops (Indu and Savithri, 2003; Babajide, 2010). Hence, in cases of desiring a combined application of organic and inorganic fertilizer materials, it is important to pre-determine the accurate proportions (in percentage) of either of the fertilizers to be applied. Therefore, this research was conducted to evaluate the performance of tomato under varying proportionate combinations of organic and chemical N-fertilizers, so as to reasonably recommend the most suitable for optimum performance of tomato in the study area.

2.0 MATERIALS AND METHODS

The experiment was conducted in the year 2015, at the Teaching and Research Farms, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria to evaluate the response of tomato to sole and combined applications of different organic and inorganic fertilizer materials. The land was manually cleared of all existing vegetation. Soil sample was collected from 0-15 cm depth and sieve through 2mm gauge to remove stones and other large particles, for determination of soil physico-chemical properties. The seeds of Roma VF variety were sown in the raised nursery bed made up of bamboo trees and shaded with palm-fronds. The seedlings were nurtured for four (4) weeks before transplanting to the field. The Six (6) treatments introduced were: T_0= the control or zero fertilizer application, T_1= application of 100% NPK 15-15-15 fertilizer, T_2= combined application of 75% NPK + 25% Rice bran, T_3= combined application of 50% NPK + 50% Rice bran, T_4 = combined application of 25% NPK + 75% Rice bran, T_5= application of 100% Rice bran. All treatments were applied at recommended rate of 60kgNha^{-1} (Babajide *et al.,* 2012). Each plot size was 2.1m × 2.7m = 5.67 m^2, at a spacing of 90cm × 30cm (0.9m x 0.30 m). The treatments were laid out in a Randomised Complete Block Design (RCBD), replicated three times. Data collection commenced after four (4) weeks of transplanting (4WAT). A water tank of 300 Litre capacities (connected to the Faculty of Agriculture bore hole), was placed at the centre of the experimental plot to ensure regular watering, using watering cans. Manual weeding was carried out with aid of hoes on every fortnight basis. The growth parameters determined at the early boom of flowering were; plant height (by using measuring tape), stem circumference (by using venier callipers which first gave the value of the diameter, converted later to circumference, using a fomular: πD (i.e. 3.142 multiplied by the original diameter (D)

value measured with calipers), number of leaves, number of branches (determined by direct counting of all well-developed branches per plant) and leaf area [by graph method as described by Akanni and Ojeniyi, (2007)]. After each harvesting, number of ripe fruits per plant was determined (by direct counting) and weighed; using Mp 600H Electronic Weighing balance. Fruit diameter was also determined (using callipers). Moreso, from multiple harvestings spanning up to eight (8) weeks, the cumulative fruit weight values per plant per treatment were determined, which were later converted to fruit yield (in tons ha^{-1}). Also, all plants per treatment were carefully packed into giant-brown envelopes (65cm by 30cm), for oven-drying at 80^0C for 72 hours to a constant weight, to assess N, P and K concentrations (as described by IITA, 1982: Babajide *et al.,* 2012), and uptakes [using a formula: Nutrient uptake = Dry matter yield multiply by Nutrient content (%)]. All data collected were analyzed following the procedures of analysis of variance (ANOVA). Duncan's Multiple Range Test (DMRT), was used to compare differences between the treatment means at 5% level of probability, using Statistical Analysis System (SAS, 2015).

3.0 RESULTS AND DISCUSSION

3.1.1 Soil physico-chemical properties

The soil's pre-cropping physico-chemical analysis results showed that the soil was slightly acidic with pH of 6.1 (Table1), and that it was very low in essential nutrient concentrations particularly N = 0.19 gkg^{-1}, P = 3.57 $mgkg^{-1}$ and K = 0.21cmolkg-1. These results corroborated the earlier research findings of Babajide *et al*., (2008) and Babajide *et al*., (2012) which indicated that the soils in the study area were grossly low in essential nutrients and mildly acidic in nature.

3.1.2 Nutrient compositions of fertilizer materials used

As indicated in Table 2, the values of nutrient concentrations in the chemical fertilizer materials used were already indicated on the bag containing the fertilizer as 15% each for N, P and K i.e. NPK 15-15-15 fertilizer grade, while those of the rice bran were analysed in the laboratory (IITA, 1982), and the results were 1.0%, 1.2% and 1.7% for N, P and K respectively. These values were relatively higher than N, P and K concentrations in some common weeds and wasteful plant residues (Babajide, 2010).

3.1.3 Growth Parameters of Tomato (*Lycopersicon lycopersicum* L. Mill) Under Combined Fertilizer Applications

Application of different fertilizers and their combinations significantly enhanced growth of tomato (Table 3). Application of 50% NPK + 50% Rice bran had significantly higher plant height (98.2cm), but the value was not significantly different from those obtained from applications of 100% NPK and other fertilizer treatments tested (except 100% Rice bran), but significantly higher than the control. Also, application of 75% Rice bran + 25% NPK produced the plant with significantly wider stem circumference value. Although the value was statistically similar to those produced by other fertilizer treatments, it was significantly higher than the control (Table 3). The highest values of both the leaf area and number of branches of tomato were observed in the application of 50% NPK + 50% Rice bran. Those values were not significantly different from other fertilizer treatments investigated, but significantly higher than the control (Table 3). Application of 75% Rice bran + 25% NPK produced the highest number of leaves, which was not significantly different from 50% NPK + 50% Rice bran and 100% Rice bran, but significantly higher than those produced from applications of both 100% NPK fertilizer and 75% NPK + 25% Rice bran, while the control had the least (Table 3). Hence, it could be deduced that the higher the level of NPK integration, the higher the possibility of leaf shedding. Also, as the level of organic fertilizer application or integration increased, delayed leaf shedding increased, and this may possibly promote indeterminate growth of tomato (Table 3). All these are in support of the research reports of Babajide (2010), who related improved sesame growth (and even prolonged leaf formation), to improved and continuous flow of soil nutrients from applied fertilizers. Also, the results were in line with research findings of Akanbi (2002), who reported improved growth of okra and maize, as induced by improved applications of both organic and inorganic fertilizers.

3.1.4 Fruit Yield and Fruit Yield Parameters of tomato (*Lycopersicon lycopersicum* L. Mill) Under Combined Fertilizer Applications

Sole application of fertilizers and their different integrations significantly influenced fruit yield and fruit yield parameters of tomato (Table 4). Applications 50% NPK + 50% Rice bran and 75% Rice bran + 25% NPK produced significantly higher and statistically similar values of fruit diameter (5.4cm and 5,3cm respectively). Application of other fertilizer treatments (75% NPK + 25% Rice bran, 100% NPK and 100% Rice bran) produced significantly lesser fruit diameters than those of 50% NPK + 50% Rice bran and 75% Rice bran + 25% NPK, but higher than the control (Table 4). Significantly earlier days to 50% flowering were observed in plants which received application of 50% NPK + 50% Rice bran, but the value was statistically similar to all other fertilizer treatments tested, but significantly higher than the control. Hence, it could be deduced that fertilizer application irrespective of the sources may possibly promote early flowering and fruiting, compared to the control. This is in line with the research reports of Akanbi, (2002) and Babajide *et al.,* (2008). Application of 75% Rice bran + 25% NPK produced teh highest number of fruits (47.0), which was not significantly different from other fertilizer treatments but significantly higher than 100% Rice bran, while the control had the least value. Fruit weight value was significantly higher in 50% NPK + 50% Rice bran, which was equally statistically similar to other fertilizers tested, while the control had the least. Integration of 50% NPK with 50% Rice bran produced the highest fruit yield (82.3 tons ha^{-1}), which was not significantly different from other fertilizers (except 100% Rice bran), while the control produced the least (Table 4). All these results corroborated the research findings of Indu and Savithri, (2003), Chukwuaka and Omotayo (2009), and Babajide and Salami, (2012) who reported enhanced crop yield as influenced by improved soil nutrition.

3.1.5 Biomass Production of Tomato (*Lycopersicon lycopersicum* L. Mill) as Influenced by Combined Fertilizer Applications

Fertilizer applications significantly improved biomass production (Table 5). The fresh below ground biomass of tomato was significantly enhanced by application of 100% NPK fertilizer. This value was not significantly different from those obtained from 75% NPK + 25% Rice bran and 50% NPK + 50% Rice bran, but significantly higher than other fertilizer treatments and the control. The dry below ground biomass production was significantly higher with application of 100% NPK, which was statistically similar to those obtained from 50% NPK + 50% Rice bran and 25% NPK + 75% Rice bran applications, but significantly higher than other fertilizer materials assayed, and the control (Table 5). Similarly, 100% NPK fertilizer application produced the highest values of fresh and dry above ground biomass. The value of fresh above ground biomass was not significantly different from 50% NPK + 50% Rice bran and 25% NPK + 75% Rice bran, but higher than other fertilizer treatments and the control. The value of dry tomato biomass obtained from NPK fertilizer application was not significantly different from those obtained from75% NPK + 25% Rice bran and 50% NPK + 50% Rice bran, but significantly higher than other fertilizers tested, while the control produced the least (Table 5). These research results are in agreement with Akanbi *et al.,* (2005), Akanni and Ojeniyi (2007) and Babajide, (2010), who reported enhanced crop yield and biomass production, under tropical climate as influenced by application of different fertilizer materials.

3.1.6 Effects of Combined Fertilizer Applications on N, P and P uptakes of Tomato (*Lycopersicon lycopersicum* L. Mill)

Application of different fertilizers and their combinations significantly influenced nutrient uptakes of tomato, compared to the control (Table 6). For the N, P and K uptakes application of 25% NPK + 75% Rice bran generally induced significantly higher uptakes, although the values were not significantly different from other fertilizers (soles and their combinations) investigated, but the values were generally higher than the control (Table 6). The results vividly supported the research findings of Babajide and Salami (2010) and Babajide (2014) who reported improved nutrient uptakes via both sole fertilizer applications and their combinations under varying agro-ecological zones and soil fertility conditions.

4.0 CONCLUSION AND RECOMMENDATION

All fertilizer materials applied significantly enhanced tomato growth, yields and nutrient uptakes, compared to the control. Locally produced rice bran is a potential fertilizer material, which could be used for efficient arable crop production. Rice bran is a dependable soil amendment, which could improve soil conditions and crop quality. Integration of rice bran with chemical fertilizer may be more effective and efficient in inducing better crop performance, than its sole application, particularly under low fertile soil conditions. Sole application of 100% NPK and Rice bran significantly improved fruit yield by 831.5% and 597.1% respectively, while their combinations significantly enhanced tomato fruit yield ranging from 819% to 1127%. Significantly delayed leaf shedding and prolonged leaf production observed in tomato plants which received rice bran applications at 50% level and above, is a good indicator of possible enhancement of prolonged flowering and fruiting, as also manifested in significantly higher fruit yields. Therefore, since there is an increasing awareness nowadays, on the environment friendly benefits of fertilizer production and usage,

application of either 75% or 100% NPK fertilizer should be totally discouraged. Hence, 75% Rice Bran + 25% NPK could be recommended or alternatively 50% Rice Bran + 50% NPK, for tomato production in the study area. This promotes continuous availability and maintenance of soil organic matter. Hence, improved soil quality and tomato production ensured. Also, alleviation of chemical fertilizer loads or inputs, as well as their residual effects established in soils, of the study area.

Table 1: Results of the physico-chemical analysis of the soil sample used

Soil Characteristics	Value
pH (H_2O)	6.10
Organic Carbon(gkg^{-1})	4.42
Total N (gkg^{-1})	0.19
Available P ($mgkg^{-1}$)	3.57
Fe (mgk^{-1})	11.10
Cu ($mgkg^{-1}$)	2.36
Zn ($mgkg^{-1}$)	2.87
Exchangeable K ($cmolkg^{-1}$)	0.21
Exchangeable Na ($cmolkg^{-1}$)	0.22
Exchangeable Ca ($cmolkg^{-1}$)	19.52
Exchangeable Mg ($cmolkg^{-1}$)	3.11
Sand (%)	75.03
Silt (%)	14.15
Clay (%)	10.82
Textural class	Sandy loam

Table 2: Nutrient compositions of fertilizer materials used

	NUTRIENT CONCENTRATIONS		
FERTILIZER MATERIALS	N	P	K

NPK FERTILIZER	15.0 %	15.0 %	15.0 %
RICE BRAN	1.0 %	1.2 %	1.7 %

Table 3: Effect of combining organic and inorganic Fertilizer materials on growth parameters of tomato (*Lycopersicon lycopersicum*)

Treatments	Plant height (cm)	Stem Circumference (cm)	Leaf Area (cm^2)	Number of Leaves	Number of Branches
Control	42.1c	0.7c	16.2b	101.0c	4.0b
100% NPK	91.3a	2.9a	34.6a	186.3b	19.2a
75% NPK + 25 % Rice Bran	90.1a	2.8a	33.2a	201.4b	18.4a
50 % NPK + 50 % Rice Bran	98.2a	2.9a	36.6a	236.5a	20.2a
25 % NPK + 75 % Rice Bran	96.6a	3.3a	35.2a	242.3a	18.2a
100% Rice Bran	82.5b	2.5ab	31.2a	232.5a	16.3a

Means followed by the same letters are not significantly different at p=0.05, using DMRT.

Table 4: Influence of combined application of organic and inorganic fertilizer materials on Fruit Attributes and Fruit yield of tomato (*Lycopersicon lycopersicum*)

Treatments	Days to 50% flowering	Fruit Diameter (cm)	Cumulative Number of Fruits	Cumulative Fruit Weight ($gplant^{-1}$)	Fruit Yield ($tons\ ha^{-1}$)
Control	92.2b	1.6c	15.0c	13.1b	7.3c
100% NPK	68.1a	4.0b	38.0ab	43.1a	60.7a
75% NPK + 25 % Rice Bran	67.6a	4.2b	39.0ab	41.4a	59.8a
50 % NPK + 50 % Rice Bran	60.4a	5.4a	46.0a	48.3a	82.3a
25 % NPK + 75 % Rice Bran	60.6a	5.3a	47.0a	45.1a	78.5a
100% Rice Bran	71.2a	3.8b	30.0b	39.2a	43.6b

Means followed by the same letters are not significantly different at p=0.05, using DMRT.

Table 5: Effect of organic and inorganic fertilizer combinations on biomass yield of tomato (*Lycopersicon lycopersicum*)

Treatments	Above- ground Biomass Fresh Weight (gplant^{-1})	Above-ground Biomass Dry Weight (gplant^{-1})	Below-ground Biomass Fresh Weight (gplant^{-1})	Below-ground Biomass Dry Weight (gplant^{-1})
Control	116.1c	28.7d	12.8c	5.1cd
100% NPK	240.1a	78.3a	30.0a	9.8a
75% NPK + 25 % Rice Bran	196.1b	67.2ab	25.0a	6.4bc
50 % NPK + 50 % Rice Bran	204.6ab	68.1ab	24.7a	7.1ab
25 % NPK + 75 % Rice Bran	200.8ab	59.5bc	22.1bc	8.6ab
100% Rice Bran	162.2b	49.4c	15.6bc	6.0bc

Means followed by the same letters are not significantly different at p=0.05, using DMRT.

Table 6: Nutrient uptakes of tomato (*Lycopersicon lycopersicum*) as influenced by organic and inorganic fertilizer combinations

	NUTRIENT UPTAKES (gkg^{-1})		
TREATMENTS	N	P	K
Control	12.4c	1.1c	1.1d
100% NPK	46.7b	9.2b	14.6c
75% NPK + 25 % Rice Bran	57.3ab	21.5a	18.6b
50 % NPK + 50 % Rice Bran	65.4a	21.2a	20.6ab
25 % NPK + 75 % Rice Bran	63.9a	24.1a	22.7a
100% Rice Bran	61.7a	22.3a	22.6a

Means followed by the same letters are not significantly diffe

REFERENCES

Adebooye, O.C.; Adeoye, G.O. and Tijani-Eniola H. (2006). Quality of fruits of three varieties of tomato (Lycopersicon *esculentum* L. Mill) as affected by phosphorus rates. Journal of Agronomy 5 (3): 396-400.

Akanbi, W. B. (2002). Growth, Nutrient uptake and yield of maize and okra as influenced by compost and nitrogen fertilizer under different cropping systems. Ph. D. Thesis, Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria pp. 232.

261 Akanbi, W. B., Akande, M. O. and Adediran, J. A. (2005). Suitability of composted maize straw and
262 mineral nitrogen fertilizer for tomato production. Journal of Vegetable Science 11(1): 57-65.

263 Akanni, D.I. and Ojeniyi, S. O. (2007). Effect of different levels of poultry manure on soil physical
264 properties, nutrients status, growth and yield of tomato (*Lycopersicon esculentum*). Journal of
265 Agronomy 1:1-4

266 Anonymous, (2000). Yield and fruit quality of tomato as influenced by mulching, nitrogen and
267 irrigation interval. *International Research Journal Of Agricultural Science and soil science*
268 *Vol. 1 (3) pp. 090 – 095.*
269 Babajide, P.A.; Olabode, O.S.; Akanbi, W.B.; Olatunji, O.O and Ewetola E.A. (2008). Influence of
270 Composted Tithonia-biomass and N-Mineral Fertilizer on Soil Physico- Chemical Properties
271 and Performance of Tomato (Lycopersicon lycopersicum). *Research Journal of Agronomy*
272 Vol. 2 (4): 101-106.
273 Babajide, P. A. (2010). Response of Sesame (*Sesamum indicum* Linn.) to Integrated Nutrient
274 Management Approach in an Alfisol, in Oyo State, Nigeria (Ph.D. Thesis), University of
275 Ibadan, Ibadan, Nigeria. 173 pp.
276 Babajide, P. A.; Akanbi, W. B; Olabode, O. S., Olaniyi, J. O. and Ajibola, A.T. (2012). Influence of
277 pre-application handling techniques of *Tithonia diversifolia* Hemsl. A.Gray residues on
278 growth, seed yield and oil content of sesame (*Sesamum indicum L.*), in south-western
279 Nigeria. *Journal of Animal and Plant sciences: Biosciences:* Vol.15 (2): 2135-2146.
280 Babajide, P.A. and T.B. Salami (2012). Effect of integrated nutrient management approach on soil
281 chemical and physical properties and performance of tomato (*Lycopersicon*
282 *lycopersicum*) under mildly acidic soil conditions. *International Journal of Applied*
283 *Agricultural and and Apicultural Research, LAUTECH, Ogbomoso, Nigeria. IJAAAR.* Vol. 8
284 (1): 91-98.
285 Babajide, P.A. (2014). Contributions of bio-organo-chemical nutrient management approach to
286 growth, yield and phytochemical composition of sesame (*Sesamum indicum* Linn.), under
287 low fertile alfisol conditions. *International Journal of Current Microbiology and Applied*
288 *Sciences.* ISSN:2319-7706. Vol.3 .No.3 (8): 957- 976.
289 Barber, N.J. and J. Barber, (2002). Lycopene and prostate cancer. *Prostate Cancer Prostatic Dis*.,
290 Vol. (5): 6-12
291 Chukwuka, K. S. and Omotayo, O. E. (2009). Soil fertility restoration potentials of Tithonia green
292 manure and water hyacinth compost on a nutrient depleted soil in south west Nigeria.
293 Research Journal of Soil Biology 1(1); 20-30.

294 Clinton, S.K. (1998). Lycopene: Chemistry, biology and implications for health and disease.
295 Nutr.Rev ., 56:35-51.
296 International Institute of Tropical Agriculture (1982). Selected Methods for Soil and Plant Analysis.
297 International Institute of Tropical Agriculture, Ibadan Nigeria. IITA Manual Series, No. 7.
298
299 Indu K. P. and Savithri K. E. (2003). Effect of Biofertilisers VS Perfected chemical fertilization for
300 Sesame grown in summer rice fallow. Journal of Tropical Agriculture 41 (2003); 47-49.
301 Rawshan, A. S. M. (1996). Effect of Plant Population Density on Tomato In: ARC-AVRDC
302 training report. Kasetsart University, Bangkok, Thailand: *ARC-AVRDC*, Pp 152-156.
303 SAS (2015). Sas Institute Inc., Cary Nc., U.S.A. (Software Statistical programme). 2015.
304 Tejada, M., Benitez, C. and Gonzatez, J. L. (2005). Effects of Application of Two Organomineral
305 Ferttilizers on Nutrient Leaching Losses and Wheat Crop. Agron. Journ. 97; 960-967