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Effect of Bionim and Agriboom Fertilizers on The Yield And Yield Attributes of Onion (Allium Cepa L.) in Sokoto, Nigeria

*Aliyu, U. [†]I.S Dalatu.,*H. G. Ahmed and [ϕ]M. Audu
** Department Of Crop Science, Usmanu Danfodiyo University, Sokoto, Nigeria*
[†]Department Of Agriculture And Bio-Environmental Engineering, Ramat Polytechnic, Maiduguri
[Φ] Department Of Soil Science, Usmanu Danfodiyo University, Sokoto, Nigeria

Abstract: Field trials were conducted at the Usmanu Danfodiyo University, Sokoto Fadama Teaching and Research Farm Kwalkwalawa Village during the 2014/2015 and 2015/2016 dry seasons to study the effect of bionim and agriboom fertilizers on yield of onion (Allium cepa L.) in Sokoto. Treatments consisted of factorial combination of five levels of each of agriboom fertilizer (0, 1000, 2000, 3000 and 4000l/ha), bionim fertilizer (0, 250, 500, 750 and 1000kg/ha) and a Red Bombay Onion variety). Treatments were laid out in a randomized complete block design (RCBD) replicated three times. Results of the study indicated that agriboom fertilizer at the rate of 4000ml/ha consistently recorded the highest values for all the parameters studied. Similarly, the use of 1000kg/ha of bionim fertilizer rate showed superiority among the treatments in all the parameters investigated. From the finding of this research it could be concluded that 4000ml/ha of agriboom organic fertilizer combined with 1000kg/ha of bionim organic fertilizer gave the best results.
Keywords: *Bionim, Agriboom, Fertilizer, Onion, Yield.*

I. INTRODUCTION

Onion (*Allium cepa* L.) is an important vegetable crop that belongs to family Alliaceae (Best, 2000). The crop is a biennial herb of central Asian origin (Fritisch and Friesen, 2002). Onion is ranked second to tomatoes in importance (Brice *et al.,* 1997). Globally, it is estimated that, over 3,642, 000 hectares are dedicated to onion production annually and total world production stands at 82,851,732 metric tons of which about 50% comes from Asia (FAOSTAT, 2012), China ranked first in onion production with production output of 22,600,000 metric tons followed by India (16,308, 990) and United States (3,277,460) respectively. Similarly in Africa, Nigeria is the largest onion producer with output production of 1,350,000 metric tons followed by Niger (1,183,268). But in terms of productivity, Niger was the highest with average production of 35.58 t/ha compared to Nigeria with 14.79 t/ha (FAOSTAT, 2012).

Onion is grown primarily for its bulb which is used for flavouring the local stew, fresh bulb and leaves are considerably important in the daily diet, mostly used as seasonings or as vegetables in stews. It is one of the richest sources of flavonoid in the human diet and flavonoid consumption has been associated with a reduced risk of cancer, heart disease and diabetes. In addition it is known for anti-bacterial, antiviral, anti-allergenic and anti-inflammatory potential (Gessesew *et al,.* 2015). Onions are very versatile and can be baked, boiled, braised, grilled, fried, roasted, sautéed or eaten raw in salads (Conant, 2006). Onion has numerous medicinal uses for treating diseases, and is used almost in all the medicinal systems.

Agriboom is liquid manure comprising of bioactive substances of vermicompost and seaweed in unique cold process and as such bioactive substances are not denatured. It provides bio energy and bio stimulants required for crops and have biologically derived nutrients and bio stimulants substances (www.agrilife.in). Agriboom organic manure provides nutrients in an organic form to plants. It also aids in cell division, cell elongation, tillering and vegetative growth. It imparts stress tolerance to withstand adverse abiotic conditions. It induces better flowering and reduces flower dropping and imparts better organoleptic qualities to the fruit and increases yield through better grain formation and fruiting (www.agrilife.in). The chemical analysis of agriboom carried out in the Soil Science Laboratory of Usmanu Dan Fodiyo University, Sokoto in 2015 revealed that it is made up of 6.34mg/l of Nitrogen, Phosphorus 4.00mg/l, Potassium 4900mg/l, Sodium 1900mg/l, Calcium 0.15mg/l and Magnesium 0.4mg/l.

Bionim fertilizer is the residual product of cold pressing of the neem seed for the extraction of the natural and organic oil. The high content of azadirachtin in bionim protects crops against a wide range of parasites and also enriches the soil. Bionim organic fertilizer acts as a natural fertilizer and protects plant root system from nematodes, soil grubs and white ants largely due to residual effect of limonoids it contained. It also reduces alkalinity in soil as it produces organic acids when decomposing (www.agrilife.in). Bionim contains a good level of NPK in organic form to support good plant growth. Being a totally botanical product, it contains 100% natural NPK content together with other essential micro nutrients. It is rich in both sulphur compounds and bitter limonoids. The main components are Nitrogen 2.0-5.0%, Phosphorus 0.5-1.0%, Potassium 1.0-2.0%,

Calcium 0.5-3.0%, Magnesium 0.3-1.0%, Sulphur 0.2- 3.0%, Zinc 15ppm to 60ppm, Copper 4ppm to 20ppm, Iron 500ppm to 1200ppm, Manganese 20ppm to 60ppm(www.agrilife.in).

With the current trends of onion production in Nigeria and the increasing demand for food due to human population pressure, dwindling land for onion production, cost and scarcity of inorganic fertilizers due to government deregulation policy, cost of high yielding varieties and poor management practices, and its production has to be increased tremendously. This could only be achieved through better plant nutrition by complimentary use of organic fertilizers and use of high yielding varieties to sustain soil fertility. The current study is undertaken to determine the effect of Bionim and Agriboom fertilizers on yield of onion (*Allium cepa* L.) and to determine the most appropriate quantity of Agriboom and Bionim organic fertilizers to be used for increased onion production.

II. MATERIALS AND METHODS

Experimental Site

The experiments were conducted during the 2014/2015 and 2015/2016 dry seasons under irrigation at the Usmanu Danfodiyo University Teaching and Research (Fadama) Farm, located at Kwalkwalawa village in Sokoto. The area is located in the Sudano Sahelian agro-ecological zone of Nigeria, Located on latitudes 13^{o} 05' 51" N and longitude 5^{o} 12′ 01" E. at an altitude of about 350m above sea level (GPRS, 2016). The climate is semi-arid with annual rainfall range of 550mm-700mm, temperature ranges from 15^{o} C to 41^{o} C and relative humidity ranges from 20-35% in the dry season and 43-78% in the rainy season (SERC, 2006). The area has cool dry period during harmattan, from November to February and hot dry spell from March to May, followed by short raining season May/June-September/October (Davies, 1982). The experimental site is usually submerged by flood water in August/September.

The treatments consisted of five levels each of Bionim organic fertilizer (0kg/ha, 250kg/ha, 500 kg/ha, 750 kg/ha and 1000 kg/ha) and Agriboom (liquid organic manure (0 ml/l, 1000 ml/l, 2000ml/l, 3000 ml/l and 4000 ml/l) , making a total of twenty five treatments combination, and check plot that received 100:60:60 of NPK laid out in a Randomized Complete Block Design (RCBD), replicated three times. Red Bombay onion variety was used for the experiment. Red Bombay is a popular short day variety in India. It is suitable for dry and warm conditions, with wide acceptance in home garden. Bulbs are medium-large, semi round in shape and red in colour, flesh is firm and pungent and it is medium to late maturity (www. Condor seed.com/onion/onion Bombay red).

The experimental site was ploughed, harrowed, leveled and worked to fine tilt. The site was then prepared into three blocks and each block measuring 10.5m x 12m ($126m^2$ gross). Within each block, 25 plots were constructed each measuring 2m x 1.5m ($3m^2$ net) with 0.5m bound separating individual plots. One meter (1m) was used to separate the blocks. Total field area was $402m^2$. Irrigation channels from the water source were constructed to deliver water to the field linking individual plots.

Bionim organic fertilizer was applied at the rate of (0kg/ha, 250kg/ha, 500kg/ha 750kg /ha and 1000kg/ha) at land preparation. Agriboom liquid organic manure was applied at the rate of 0ml/l, 1000ml/l, 2000ml/l, 3000ml/l and 4000ml/l at 4 weeks after transplanting. NPK in the form of 100:60:60 was split applied at the rate of 50kg/ha at 4 and 6 weeks after transplanting to the check plots.

Seedlings of six weeks old were used as transplants and transplanting spacing of 15cm inter and 10cm intra spacing was used. Transplanting was done on 15^{th} January, 2015 and 5^{th} December, 2015 for first and second trials respectively. Weeding were done manually using a small onion weeding hoe, and weeding frequency was determined by the degree of weed infestation in the field in order to maintain weed free environment.

The data collected on yield parameters such as Bulb weight, Fresh bulb yield, Cured bulb weight, Cured bulb yield, and bulb diameter. Data collected were subjected to analysis of variance (ANOVA) using STATISTIX 8.0 computer package. Duncan's New Multiple Range Test (DMRT) was used to separate the significant means.

III. RESULT AND DISCUSSION

Bulb Weight

The results on mean bulb weight of onion for agriboom and bionim fertilizers during 2014/2015 and 2015/2016 dry seasons and the two years combined were shown on Table 1. Bulb weight was significantly ($P<0.01$) affected by both agriboom and bionim fertilizers in the two seasons and the combined. Agriboom at the rate of 4000ml/ha consistently produced the heaviest bulb weight for 2014/2015, 2015/2016 and combined. The unfertilized check also consistently recorded the least bulb weight for both seasons and combined. Similarly, the same trend was observed with bionim fertilizer in which 1000kg/ha of bionim recorded the heaviest bulb weight in both seasons and combined whereas the least bulb weight was recorded with the control in all the seasons studied and the combined. From these results, it was observed that there a direct relationship

between the two organic fertilizers and bulb weight and could be due to the fact that as level of agriboom and bionim fertilizers increased, more nutrients were added to the soil which adequately provided enough nutrients for plant's photosynthesis and consequently increased assimilates production which are partitioned to the bulbs. This results was supported by previous findings of Gambo et al. (2008) while studying the effects of Farmyard Manure, Nitrogen and Weed Interference on the Growth and Yield of Onion (*Allium cepa* L.) at the Sokoto Rima Valley where they observed that increasing rates of farmyard manure tended to increase bulb yield of onion with the highest values at 30 tons/ha. The interaction effects of agriboom and bionim fertilizers on the single bulb weight of onion for the two years combined were significant ($P<0.01$).

Fresh Bulb Yield

Results on fresh bulb yield of onion as affected by agriboom and bionim fertilizers during 2014/2015 and 2015/2016 dry seasons and the combined are presented in Table 1. Significant effect ($P<0.01$) of agriboom fertilizer was observed on the fresh bulb yield in both season and the combined. Agriboom at the rate of 3000ml/ha recorded the highest fresh bulb yield in the first season and in the 2015/2016 trial, agriboom at the rate of 4000ml/ha recorded the highest fresh bulb yield. In the combined, similar trend was observed in the first season.

Bionim fertilizer affected fresh bulb yield significantly ($P<0.01$) for both seasons and the combined. Application of 1000kg/ha bionim fertilizer recorded the highest fresh bulb yield followed by application of 750kg while the least fresh bulb yield was obtained with control for 2014/2015and 2015/2016 respectively. In the combined, similar trend was observed. From these results, it was observed that there is a relationship between bionim fertilizer and fresh bulb yield and could be due to the fact that as level of bionim increased, more nutrients were added to the soil which adequately provided enough nutrients, plant's photosynthesis and consequently increased assimilates production which are partitioned to the bulbs. This result was supported by previous findings of Gambo et al (2008). Similarly, significant ($P<0.01$) interaction was observed between agriboom and bionim fertilizers on the fresh bulb yield of onion in the two years combined.

Cured Bulb Weight

Results on cured bulb weight of onion as affected by agriboom and bionim fertilizers treatment during 2014/2015 and 2015/2016 dry seasons and the two years combined were presented in Table 2. Cured bulb weight was significantly ($P<0.01$) affected by agriboom fertilizer for 2014/2015 and 2015/2016 dry seasons and the combined. Agriboom at the rate of 4000ml/ha recorded the heaviest cured bulbs followed by 3000ml/h and 2000ml/ha while the least cured bulb weight was recorded with the control in both seasons. In the combined results same observation was made with 2014/2015 and 2015/2016 dry seasons was made. This result is in agreement with the findings of Soleymani and Shahrajabian (2012) which revealed that maximum bulb weight and favorite yield was related to application of 200kg/ha of bionim fertilizer.

Bionim fertilizer significantly ($P<0.01$) affected cured bulb weight in both years and the combined. Application of 1000kg/ha of bionim fertilizer recorded the heaviest cured bulb weight followed by 500kg/ha and 750kg/ha for the 2014/2015 and 2015/2016 dry seasons respectively, and the least cured bulb weight was recorded with control. In the combined, similar results was observed. This finding collaborates that of Aisha *et al* (2007) who reported that, higher yield of onion could be attributed to the high growth rate of onion plant and greater number of leaves per plant resulting from the application of 30t/ha of organic manure which contributed significantly to the greater mean bulb weight and bulb diameter. Similarly, significant ($P<0.01$) interaction was observed between agriboom and bionim fertilizers on the cured bulb weight of onion in the two years combined.

Cured Bulb Yield

Results on cured bulb yield of onion as affected by agriboom and bionim fertilizers during 2014/2015 and 2015/2016 dry seasons and the two years combined is presented in Table 2. Cured bulb yield was significantly ($P<0.01$) affected by agriboom during fertilizer 2014/2015 and 2015/2016 dry seasons and the combined. Agriboom at the rates of 4000 and 3000ml/ha recorded the highest cured bulb yield followed by 2000ml/ha in the first trial while the least cured bulb yield was recorded with the control treatment. In the second season 4000ml/ha of agriboom produced the heaviest cured bulbs followed by 3000ml/ha of agriboom. In the combined, 4000ml/ha of agriboom recorded the heaviest cured bulbs.

Bionim fertilizer significantly ($P<0.01$) affected cured bulb yield of onion in both seasons and combined. Application of 1000kg/ha of bionim fertilizer recorded the highest cured bulb yield followed by 750kg/ha for the 2014/2015 and 2015/2016 dry seasons, and the least cured bulb yield was observed with the control in the both trial. In the combined, similar trend was observed. These findings are in agreement with those reported by El-Shatanofy and Manar (2011) who concluded that fertilization of onion plants with farm yard manure and spraying agrispon increased onion yield. Similarly, significant ($P<0.01$) interaction was observed between agriboom and bionim fertilizers on the cured bulb yield of onion in the two years combined.

Bulb Diameter

Results on bulb diameter as affected by agriboom and bionim fertilizers during 2014/2015 and 2015/2016 dry seasons and the two years combined are presented in Table 3. Significant ($P<0.01$) effect was observed on bulb diameter due to different levels of agriboom and bionim fertilizers for both seasons and combined. 4000ml/ha of agriboom significantly recorded the highest mean bulb diameter followed by 3000ml/ha and 2000ml/ha while the least bulb diameter was recorded with the control for the 2014/2015 and 2015/2016 dry seasons respectively. In the combined, similar trend was noted.

Significant variation ($P<0.01$) observed on bulb diameter due to different levels of bionim fertilizer applied. The use of 1000kg/ha of bionim resulted in significantly maximum bulb diameter followed by 750kg/ha bionim rate while the least bulb diameter recorded with the control in the 2015/2016 dry season. In the combined, the same trend was observed but least bulb diameter was recorded when 500kg/ha bionim was applied. This result suggest that application of large quantity of organic fertilizer improved soil fertility and structure thereby making it possible for onion plants to adjust it bulb size. This investigation was supported by Yoldas *et al* (2011) while observing the Effect of Organic and In-organic Fertilizers on Yield and Mineral content of Onion (*Allium cepa* L.) observed maximum bulb width (7.89cm) when 60t/ha of organic manure applied to onion plants. Patil (1995) observed maximum bulb diameter of 6.43, 4.92 and 2.98cm in big, medium and small size bulbs respectively when onion was nourished with compost. Similar views were showed by Jambhekar (1996) who reported maximum bulb diameter and bulb size index in Light Red onion when it was supplemented with compost. Significant ($P<0.01$) interaction was observed between agriboom and bionim fertilizers on bulb diameter for the two years combined.

CONCLUSION

From the findings of this research, it may be concluded that 4000ml/ha agriboom fertilizer rate combined with 1000kg/ha of bionim fertilizer rate gave the best result. It is therefore suggested as the best practice. However, more research work needs to be conducted which include higher rate of agriboom and bionim fertilizers to substantiate whether the increase in levels of agriboom and bionim fertilizers could result in further increase in bulb yield or otherwise, so as to establish the optimum levels of agriboom and bionim fertilizers for onion growers in Sokoto, Nigeria.

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Table 1: Mean bulb weight (g) and fresh bulb yield of onion as affected by agriboom and bionim fertilizers during 2014/2015 and 2015/2016 dry seasons and the two years combined at Sokoto

	Bulb Weight(g)			**Fresh Bulb Yield(t/ha)**		
	2014/2015	2015/2016	Combined	2014/2015	2015/2016	Combined
Agriboom rate(A)						
0ml/ha	57.73^{d}	111.00^{e}	84.36^{e}	12,822^{c}	18,058^{d}	15,440^{d}
1000ml/ha	59.38^{c}	133.13^{b}	96.25^{c}	13,748^{b}	19,500^{c}	16,624^{c}
2000ml/ha	69.98^{b}	129.13^{c}	99,55^{b}	15,000^{a}	20,444^{b}	17,722^{b}
3000ml/ha	69.23^{b}	121.10^{d}	95.17^{d}	15,033^{a}	21,444^{a}	18,238^{a}
4000ml/ha	74.10^{a}	140.14^{a}	107.12^{a}	12,867^{c}	21,498^{a}	17,182^{b}
Significance	**	**	**	**	**	**
SE±	0.5787	0.3115	0.4451	124.93	101.45	113.19
Bionim rate(B)						
0kg/ha	59.56^{d}	120.19^{d}	89.88^{d}	12,944^{c}	18,900^{e}	15,922^{e}
250kg/ha	65.38^{b}	116.42^{e}	90.90^{c}	13,048^{c}	19,191^{d}	16,119^{d}
500kg/ha	66.11^{b}	131.13^{c}	98.62^{b}	14,144^{b}	19,520^{c}	16,832^{c}
750kg/ha	63.54^{c}	132.45^{b}	98.00^{b}	13,822^{b}	20,678^{b}	17,250^{b}
Significance	**	**	**	**	**	**
SE±	0.5787	0.3115	0.4451	124.93	101.45	113.19
Interaction						
A X B	**	**	**	**	**	**

Means within a column followed by similar letter(s) are not significantly different at 5% probability level of Duncan's Multiple Range Test (DMRT).
** = *Significant at 1% probability level.*
Ns = *Not significant at 5% probability level of the F-test*
A = Agriboom fertilizer
B = Bionim fertilizer
WAT= Weeks after transplanting

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Table 2: Mean cured bulb weight (g) and cured bulb yield (t/ha) of onion as affected by agriboom and bionim fertilizers during 2014/2015 and 2015/2016 dry seasons and the two years combined at Sokoto

	Cured Bulb Weight(g)			Cured Bulb Yield(t/ha)		
	2014/2015	2015/2016	Combined	2014/2015	2015/2016	Combined
Agriboom rate(A)						
0ml/ha	61.86^{d}	96.16^{e}	79.01^{e}	10.566^{b}	15.999^{c}	13.266^{d}
1000ml/ha	62.40^{d}	105,61^{d}	84.00^{d}	10.266^{b}	19.333^{a}	14.799^{b}
2000ml/ha	74.80^{c}	116.99^{c}	95.89^{c}	11.099^{b}	17.766^{b}	14.433^{c}
3000ml/ha	76.14^{b}	119.51^{b}	97.82^{b}	12.266^{a}	18.233^{b}	15.266^{b}
4000ml/ha	80.64^{a}	120.90^{a}	100.77^{a}	12.266^{a}	19.399^{a}	15.833^{a}
Significance	**	**	**	**	**	**
SE±	0.5803	0.2250	0.4026	121.63	98.15	109.89
Bionim rate(B)						
0kg/ha	67.72^{c}	104.39^{e}	86.05^{e}	10.633^{bc}	17.033^{c}	13.833^{c}
250kg/ha	68.43^{c}	105.68^{d}	87.05^{d}	11.299^{b}	17.433^{c}	13.766^{bc}
500kg/ha	73.50^{b}	112.85^{c}	93.17^{b}	11.499^{b}	17.133^{c}	14.299^{bc}
750kg/ha	68.88^{c}	115.17^{b}	92.02^{c}	10.366^{c}	18.866^{b}	14.599^{b}
1000kg/ha	76.50^{a}	121.07^{a}	98.78^{a}	12.633^{a}	20.233^{a}	16.433^{a}
Significance	**	**	**	**	**	**
SE±	0.5803	0.2250	0.4026	121.63	98.15	109.89
Interaction						
A X B	**	**	**	**	**	**

Means within a column followed by similar letter(s) are not significantly different at 5% probability level of Duncan's Multiple Range Test (DMRT).
*** = Significant at 1% probability level.*
Ns = *Not significant at 5% probability level of the F-test*
A = Agriboom fertilizer
B = Bionim fertilizer
WAT= Weeks after transplanting

Table 3: Mean bulb diameter (cm) of onion as affected by agriboom and bionim fertilizers during 2014/2015 and 2015/2016 dry seasons and the two years combined at Sokoto

	2014/2015	2015/2016	Combined
Agriboom rate(A)			
0ml/ha	4.94^{b}	6.11^{c}	5.32^{c}
1000ml/ha	5.05^{b}	6.19^{c}	5.62^{b}
2000ml/ha	5.21^{ab}	6.38^{b}	5.79^{ab}
3000ml/ha	5.22^{ab}	6.34^{b}	5.78^{ab}
4000ml/ha	5.43^{a}	6.48^{a}	5.95^{a}
Significance	*	**	**
SE±	0.1010	0.0340	0.0675
Bionim rate(B)			
0kg/ha	5.12	6.06^{d}	5.59^{b}
250kg/ha	5.21	6.22^{c}	5.71^{ab}
500kg/ha	5.34	6.38^{b}	5.36^{c}
750kg/ha	4.94	6.35^{b}	5.64^{b}
1000kg/ha	5.25	6.48^{a}	5.86^{a}
Significance	Ns	**	**
SE±	0.1010	0.0340	0.0675
Interaction			
A X B	Ns	**	**

Means within a column followed by similar letter(s) are not significantly different at 5% probability level of Duncan's Multiple Range Test (DMRT).
*, ** = Significant at 5 % and 1% probability level respectively.*
Ns = *Not significant at 5% probability level of the F-test*
A = Agriboom fertilizer
B = Bionim fertilizer
WAT= Weeks after transplanting