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PERFORMANCE EVALUATION OF BRANDS OF ATRAZINE IN SOUTH WEST NIGERIA

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Abstract: A field experiment was carried out at Ladoke Akintola University of Technology Teaching and Research Farm, Ogbomoso, Oyo Sate to evaluate the performance of atrazine (2-chloro-4-(ethylamine)-6-(isopropyl amine)-5-triazine) produced by selected manufacturers for weed control in maize. The experiment was laid out in a randomized complete block design arranged in a split plot with 20 treatments replicated three times. The treatments include five manufacturers' brands of atrazine (Atraforce, Atraz, Multrazine, Unicorn and Vestrazine) as major treatments and four rates of application (0, 25, 50, and 100% of the recommended rate) as minor treatments. Maize variety used was OBA Super and the herbicides were applied pre-emergently to a rain wetted soil while hoe weeding served as control. Result showed that the herbicide brands and application rate had no significant effect on maize growth parameters, though both had significant effect on maize yield (p=0.05). The highest yield of maize was obtained from Atraz (2362.79kg/ha) while the least maize yield was obtained from Atraforce (1338.80 kg/ha). Herbicide brand and rate also had no significant effect on weed population density and dry matter yield. The highest worm cast population (12.2) was obtained from Unicorn plot though this was not significantly different from values from Atraforce and Atraz while multrazine recorded the least number of worm cast (5.4). Earthworm cast population was only comparable to the control when the dosage rate does not exceed 50% of the recommended rate.

Keywords: Herbicide brand, Rate, Weed Density, Worm cast.

INTRODUCTION

Atrazine, (2-chloro-4-(ethylamine)-6-(isopropyl amine)-5-triazine) is a selective, systemic, pre-emergence herbicide. It is used primarily for the control of broadleaf and grassy weeds in maize, sorghum, pineapple and sugarcane (Akobundu, 1987). Globally, Atrazine is used in the production of maize, sorghum, sugarcane, pineapple, chemical fallows, grassland, macadamia nuts, and conifers and for industrial weed control (Tomlin, 2000), with biggest market in maize production. In Europe its use is concentrated on maize, orchards and vineyards. In 1998, it was the most widely used maize herbicides in the US applied to 69% of

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the maize acreage (Dewar, 1998). The world market for Atrazine is worth over $400 million at the user level (Hicks, 1998). In the UK, Atrazine is not widely applied; however, it does have significant uses in maize production and for general weed control, for which there are no alternatives (Davis, 1993).

Atrazine is mainly absorbed through the plant roots and accumulates in the apical meristems and leaves where it inhibits photosynthesis and interferes with other enzymic processes. Novartis is Atrazine's largest manufacturer (Hicks, 1998). It is one of their best selling products though it is also manufactured by a number of other companies and has a range of trade names including Marksman (Novartis), Coyote (Defensa), Atrazina (cequisa), Atrazol (spicum), Vectal (Aventis) (Tomlin 2000). As with the consumption of various items in the market, farmers in Nigeria are quick to show preference to a particular brand of Atrazine over and above others on the ground of unverified claims of superior effectiveness. Consequence to this, marketers tend to inflate the prices of such brands in high demand. In some cases, farmers refuse to buy and use other brands if the preferred is exhausted. Invariably farmers will prefer to wait for the next stock even at the risk of missing the critical period of application. From the foregoing therefore, there is the need to investigate the efficiency of Atrazine brands being manufactured by various companies and sold in Nigerian Agro allied products markets under different brand names with a view to ascertaining their effectiveness for weed control in maize and assessing their effects on earthworm population of the soil.

MATERIALS AND METHODS

The field experiment was carried out at the Teaching and Research Farm of Ladoke Akintola University of technology, Ogbomoso during the raining seasons of 2010 and 2011. The experimental soil in 2011 has pH (H_2O) 6.0, Organic C (%) 1.9, Total N 0.26, Available P (ppm) 4.93, Exchangeable K (Meq/100g) 0.42, Sand (%) 87, Silt (%)9, Clay (%) 4. Year 2012 has pH (H_2O) 6.3, Organic C (%) 1.6, Total N 0.18, Available P (ppm) 5.98, Exchangeable K (Meq/100g) 0.38, Sand (%) 88, Silt (%) 10, and Clay (%) 2. There were 20 treatments laid out in a randomized complete block experiment (RCBD) arranged in split plots. There were five (5) major treatments i.e Atrazine brands from 5 different manufacturers. The brands were Atraforce, Atraz, Multrazine, Unicorn, and Vestrazine, each containing 800g a.i/kg. There were four (4) minor treatments i.e. rates of application, namely 0, 25, 50 and 100% of the recommended dosage rate of 2.5 kg *a.i*/ha. There were three replicates. The total area of the experimental plot was 52×41. Each replicates was separated

from the other by $1m$ avenue and the plot size was $3m \times 3m$. Maize variety OBA SUPER, obtained from a farmer's shop in Ogbomoso was planted at 3 seeds/hole on May 1, 2010, and May 6, 2011 at a spacing of 75 cm × 50 cm after the land had been prepared by disc ploughing and manual leveling. The herbicides were applied on rain wetted soil, using the knapsack sprayer model Cp3 calibrated to deliver at spraying volume rate of 200l/ha. The maize was thinned to 2 plants/stand to give a plant population of 53,333 plants/ha. The control (0%) had 2 hoe weedings at 3 weeks after planting (WAP) and 5WAP. NPK fertilizer 15-15-15 was applied at 4WAP at the rate of 5 g/plant (133 kg/ha). Data were collected for stem diameter, number of leaves/ plant, plant height, leaf area, number of seeds/cob and estimated yield per hectare (kg/ha). Data were also collected for weed density, weed dry matter yield and earthworm cast population. Mean data over the two years were subjected to analysis of variance and means were compared using the Duncan's Multiple Range Test at 5% level of probability.

RESULTS

Herbicides brand had no significant effect on maize growth parameter (Table 1). Similarly, there were no significant (p = 0.05) difference in the effect of rate of application of various herbicides on the growth parameter of maize at flowering (Table 2). Herbicide brand had significant effects on maize yield (Table 3). The highest number of seed/cob (538.92) obtained with Atraz was significantly superior to those of Vestrazine and of Atraforce (461.33 and 453.75). The value was however comparable to those of Unicorn and Multrazine (541.70 and 506.67). Vestrazine and Atraforce with the smallest number of seeds/cob (461 and 453) were not significantly different from one another. The highest yield estimate was obtained with Atraz (2361.79kg/ha) which was significantly higher than those of other treatments, while Atraforce had the lowest yield. Maize yield under the brands followed the order: Atraz > Unicorn ≥ Multrazine >Vestrazine ≥Atraforce (Table 3).

Application rate also had significant (p = 0.05) effect on maize yield (Table 4). The highest number of seed/cob (558.9) was obtained at 50% of the recommended rate which was however not significantly different from (526.9) obtained when 100% of the recommended rate was used. The least number of seeds/cob (427.6) was obtained with the control (0%). Similarly, the highest yield (2280.45 kg) was obtained with 50% of the recommended rate which was significantly higher (p = 0.05) than values obtained from other treatments. The least value (1487.99 kg/ha) was obtained from the control (0%).

Application rate had significant effects on weed population density, weed dry matter yield and worm cast population (Table 4). For weed population density, the highest weed population (9.8) was obtained from the control plot. This was significantly higher than values from other rates. The least value (5.7) was obtained when 50% of the recommended rate was used. Weed dry matter yield followed the same trend as in population density while worm cast population (11.60) was obtained from the control (0%). This value was however comparable to 25% and 50% (9.4, 9.6 respectively) but significantly higher (p= 0.05) than values obtained when 100% of the recommended rate was used (8.7).

Herbicide brand had no significant effect on weed population density and weed dry matter yield. But for Multrazine, all the herbicides were comparable to the control with respect to weed population. Atraz, (7.9), was not significantly different from Multrazine (7.3), Unicorn (7.0), and Atraforce (6.1) with respect to weed population. Weed population density number Vestrazine (5.6) was significantly (p = 0.05) lower than that of Atraz, but similar to those of other brands. The highest value for weed dry matter yield was obtained with Unicorn (4.3g) while the least, (3.4g), was obtained from plot treated with Atraz (Table 5).

The highest worm cast population (12.2) was obtained with Unicorn, which was however not significantly (p = 0.05) different from those of Vestrazine, Atraforce and Multrazine. The least value (5.4) was obtained under Multrazine.

DISCUSSION

The similarity in the growth parameters of maize at flowering across the herbicide brands suggests that brand name does not have any significant implication on the effectiveness of the herbicide. Similarly, growth parameters were not statistically influenced by the application rate in the present study. This attests to the reports of previous researchers who also observed that rate as low as 25% of recommended rate of Atrazine gave similar results as 100% (Olabode *et al.*, 2010).

Reduced competition between weeds and maize crop for water, soil nutrient and space could be adduced for higher yield obtained from the treated plot than the control (0%). Udensi *et al.*, (1999) had reported higher maize grain yield in herbicide treated plot than hoe weeded plots. The high value recorded for weed density under Atraz may be due to the fact that majority of the weeds present were sedge and grasses with similar physiology and growth requirements with maize. Atrazine does not control sedges and grasses. Similar reason may be responsible for high weed dry yield under Unicorn. However a closer look at the weed

population density and dry matter yield as affected by the herbicide brand shows a great similarity thereby implying that the sharp differences in grain yield from respective treated plots may not have been due to herbicide effectiveness since they are all similar in their efficiency in weed control. It is likely that other factors including topography may have played a significant role in the observed variations. The least worm cast population recorded on Multrazine plots suggested that the brand likely contains inert substances that are injurious to earthworm. The herbicides treated plots had lower number of worm cast population than control (0%). However, the differences were not significant except at 100% application rate. This is a further confirmation that higher dosage rate, as recommended for Atrazine application, is injurious to earthworm. These results show that with lower dosage, soil organisms may not be significantly affected negatively (Olabode *et al.*, 2010). Similarly, various researchers (Vaclav, 1998, Edwards, 1980) had reported that herbicides, especially atrazine, are toxic to earthworm.

CONCLUSION

The results of this experiment have shown that the Atrazine brands presently available to farmers in Nigeria are not different from one another in effectiveness. Farmers' claim of one herbicide brand being more efficient than the other may be as a result of faulty measurement, wrong application e.g. variation in time of application after soil preparation, application in anticipation of rain, use of faulty equipments, use of polluted water etc. It is also believed that the satisfactory weed control efficiency of the tested brands of Atrazine, at lower rate is expected to address the problem of persistence of the herbicide. As well as its toxicity to soil microbes especially at least at rates higher than 50% of the recommended rate. Low rate is also likely to reduce reported pollution problems that are associated with the use of the herbicide.

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Table 1: Effect of Atrazine brand on the growth and yield parameters of maize at flowering and maturity stages.

Herbicide brand	Plant height (cm)	Stem diameter (cm)	Number of leaves	Leaf area (cm^2)	Number of seeds/cob	Number of seeds/cob
Atraz	1.82a	0.075ab	14.73a	0.067a	538.92a	538.92a
Vestrazine	1.98a	0.086a	14.56a	0.068a	541..17a	541..17a
Multrazine	1.78a	0.083ab	14.48a	0.069a	506.67ab	506.67ab
Unicorn	1.71a	0.074b	14.42a	0.072a	461.33bc	461.33bc
Atraforce	1.6a	0.076ab	14.50a	0.073a	453.75c	453.75c

Value followed by the same letter(s) superscript along the column are not significantly ($p = 0.05$) different by DMRT.

Table 2: Effects of Application rate of Atrazine on growth parameters of maize at flowering

Herbicide brand	Plant height (cm)	Stem diameter (cm)	Number of leaves	Leaf area (cm^2)
Rate 1 (R_1) 0%	1..72a	0.078a	14.57a	0.068a
Rate 2 (R_2) 25%	1.71a	0.078a	14.40a	0.070a
Rate 3 (R_3) 50%	1.72a	0.080a	14.75a	0.070a
Rate 4 (R_4) 100%	1.73a	0.078a	14.27a	0.071a

Values followed by the same letter superscript along the column are not significantly (p = 0.05) different by DMRT.

Table 3: Effect of Atrazine brand on maize yield

Herbicide brand	Number of seeds/cob	Estimated yield (kg/ha)
Atraz	538.92a	2362.79a
Vestrazine	541..17a	2106.54b
Multrazine	506.67ab	1992.42b
Unicorn	461.33bc	1468.12c
Atraforce	453.75c	1338.80c

Values followed by the same letter superscript along the column are not significantly (p = 0.05) different by DMRT.

Table 4: Effects of rate of application of Atrazine on Maize grain yield, weed population, weed dry matter yield and worm cast population.

Application rate	Number of seeds/cob	Estimated yield (kg/ha)	Weed population density	Weed dry matter yield	Worm cast population
0%	427.60c	1487.99d	9.777a	19.000a	11.601a
25%	488.07b	1931.61b	5.777ab	7.800b	9.356ab
50%	558.93a	2280.45a	5.733b	6.067b	9.577ab
100%	526.87ab	1714.89c	5.933	3.133b	8.744b

Values followed by the same letter superscript along the column are not significantly (p = 0.05) different by DMRT.

Table 5: Effects of Atrazine brand on weed population, dry matter yield and worm cast population.

Brand name of herbicide	Weed population density (unit/25cm^2	Weed dry matter yield g/25cm^2	Worm cast population unit/25cm^2
Atraz	7.9433a	3.417b	11.585ab
Vestrazine	5.5825b	9.667ab	9.389abc
Multrazine	7.3333ab	5.833ab	5.361c
Unicorn	7.0275ab	14.250a	12.222a
Atraforce	6.1400ab	11.833ab	10.042ab

Values followed by the same letter(s) superscript along the column are not significantly (p = 0.05) different by DMRT.