American Journal of

Plant Nutrition and Fertilization Technology

ISSN 1793-9445

Academic
Journals Inc.

www.academicjournals.com

OPEN ACCESS American Journal of Plant Nutrition and Fertilization Technology

ISSN 1793-9445
DOI: 10.3923/ajpnft.2016.1.7

Review Article
Response of Weeds and Crops to Fertilization Alone or in Combination with Herbicides: A Review

Mick Assani Bin Lukangila

Department of Phytotechny, Faculty of Agricultural Sciences, University of Lubumbashi, Lubumbashi, Democratic Republic of Congo

Abstract
Weed management remains a major concern for farmers in developed countries than in developing countries. To produce better, farmers in developing countries seek to keep weeds below the economic threshold. Fertilization as weed management mode did not allow to overcome this challenge because except its effects on crops, fertilization stimulates seed dormancy in the seed stock of previous season and the growth of some weed species. In this regard, nitrogen was one of the responsible macronutrients. Therefore, splitting doses of mineral fertilizers resulted in better growth and development of crops. As for organic amendments, their effectiveness is dependent on the origin, nature and shelf life etc. Furthermore, the combination of fertilizers and herbicides resulted in non-additivity of effects especially herbicide is rapidly degraded in the soil but most herbicides containing the radical urea have made an exception. Physico-chemical properties of soils, application moments and compatibility of active ingredients are determining factors of fertilizer and herbicide efficiency.

Key words: Weed management, fertilization, herbicides, crops, farmers

Received: May 07, 2016 Accepted: May 25, 2016 Published: September 15, 2016

Citation: Mick Assani Bin Lukangila, 2016. Response of weeds and crops to fertilization alone or in combination with herbicides: A review. Am. J. Plant Nutr. Fert. Technol., 6: 1-7.

Corresponding Author: Mick Assani Bin Lukangila, Department of Phytotechny, Faculty of Agricultural Sciences, University of Lubumbashi, Lubumbashi, Democratic Republic of Congo

Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Weeds compete for nutrients, water, light and space with crops. Depending on the type of crops, these interactions generally result in the loss of yields in useful products namely; stems, leaves, tubers, roots and seeds[1].

Therefore, the presence of weeds in a cultivated field would be overwhelmingly attributed to anthropogenic activities to replace them with crops. Reinfection of the modified habitat being widely promoted by the seed bank or other products propagating organs of the previous season[2]. Generally, the ability of crops to compete with weeds becomes more efficient when the mineral or organic elements of the substrate are easily assimilated by the crop and they are not limiting factors for the growth and yield[3].

However, the types and quantities of amendments applied may influence either vegetative growth of the crop or weeds especially, both have the same nutrient requirements. For basic fertilizer (NPK), it was established in cultivated fields its spreading on the surface stimulates weed flora and unlike burial at a shallow depth[4-7] such 5 cm.

Beyond the plant already established in the habitat, according to Bajwa *et al.*[8] fertilization could influence the activation or inhibition of seed stock germination from previous years especially, when stimulus such as light, changes in temperature and rainfall are added[9,10].

In developing countries, weed chemical control proves to be a quick option in terms of time savings to cover a large area, unlike manual weeding which consume about 50% of time spent on other operations of crop maintenance although, leading sometimes to good results for certain crops such as common bean especially, the frequency of interventions come before biological damage threshold of weeds to crops. Generally in this part of the continent, this practice is essentially family hence its inefficiency[11-13].

With a view to provide better weed control to promote sustainable agriculture. This study has offered to make a digest of some studies on the evaluation of effects induced by fertilization alone or combined with chemical control of the flora of weeds and crops.

Fertilization effects on weeds and crops: The growth and development of plants are determined by their ability to remove nutrients available in the soil followed by their distribution to various organs[14].

However, most weeds have high efficiency in nitrogen removement but, it depends on the types of species and environmental conditions such was the case of the strong competitiveness of wild oats (*Avena fatua* L.) in wheat culture[15-17].

Physico-chemical properties of soil can not be ignored in explaining the effect of fertilizer on the seed bank because of sandy soil nitrogen fertilizer has greatly stimulated seed germination of wild oats (*Avena fatua* L.) unlike soil rich in organic matter when the same dose did not induce effects on the same seeds[18].

According to Gallandt[19] and Davis[20], a soil has rich organic matter, there is a high diversity and abundance of microorganisms that destroy seed bank as a source of energy extracting the carbon or nitrogen to ensure their survival.

Moreover, Chee-Sanford *et al.*[21] argued that the degree of microbial seed predation depends on several factors of colonization rates, mutual adaptation of each microbial population to environmental conditions and the physical nature of the seed coat etc.

Indeed, organic manure is more suitable in improving soil fertility compared to synthetic fertilizers. Moreover, growing period length of crops remains an important factor governing interactions with weeds which would justify splitting amendments in relation to different phenological phases of the crop. According to Alcoz *et al.*[22] this practice allows the crop to ensure efficient use of nutrients while, further limiting losses of some elements such as nitrogen; denitrification, leaching in case of heavy rains and volatilization in presence of high temperatures.

In this perspective, the results of Paolini *et al.*[23] showed strong competitiveness sunflower face *Chenopodium album*, *Solanum nigrum* and *Xanthium strumanium* after splitting nitrogen at 50% in pre-sowing growth and 50% in the production phase to control *Sinapis arvensis*. Supporting this idea, Soares *et al.*[24] showed that in cassava culture NPK application or 70 kg N ha^{-1}, 17.5 kg P ha^{-1} and 25 kg K ha^{-1} at planting moment substantially reduces weed density unlike the formula (NK) or 60 kg ha^{-1} N and 50 kg ha^{-1} K applied 350 days after planting favored the massive invasion of culture by; *Brachiaria plantaginea*, *Sida rhombifolia*, *Pavonia cancellata, Setaria parviflora* and *Cynodon dactylon* following the inability of culture to produce enough leaves in the production phase. Moreover, the binding effect of water stress the cultivated plant to lose much of its leaves.

In cereal crops including rice straw and wheat, it was shown that the low dose of NPK (50%) stimulates *Cyperus rotundus* growth. Doubling the dose of NPK (100%) combined with 10 t ha^{-1} of manure, high species richness and diversity were observed with the pre-dominance of hardwoods[25]. At this level, it should be emphasized that the farm manure enhances the action of mineral fertilizers but this is not evident if taking into account of manure nature[26] cow manure-based fertilizer stimulates the dormancy of weed seeds which largely contributes to the rapid infestation of the field especially, when used alone. This emerges from a study by Gana[27] in sugarcane culture where 10 t ha^{-1} of cattle manure promoted the proliferation of weeds and the opposite trend was observed when combined with NPK (120 kg N ha^{-1}, 26 kg P ha^{-1} and 37 kg K ha^{-1}).

The efficiency of farm manure on soil productivity, crop and weed control depends on the intrinsic and extrinsic factors. Therefore, Mahadi *et al.*[28] demonstrated that the duration and conditions of farm manure conservation influence the content and availability of nutrients like N, P, K, Ca, Mg and C among them only organic carbon has seen its content will increase for two years of storage. Considering the origin of the organic matter, results obtained by Jiang *et al.*[29] do not corroborate those of its predecessors because organic fertilizer made of pig excrement-based reduces significantly in the field the germination of seeds in the seed stock of six species, *Eleocharis acicularis*, *Monochoriav aginalis*, *Polygonum lapathifolium*, *Ammannia baccifera, Cyperus difformis* and *Ammannia aarenaride.* Huang *et al.*[30] reported that 22.5 t ha^{-1} of pig excrement combined with mineral fertilizers (NPK) substantially stimulate weed density in rice, unlike the N (90 kg ha^{-1}), P (20 kg ha^{-1}) and K (62 kg ha^{-1}) alone or in the form of NPK.

Some studies showed the impact of crop genotype on the uptake and the use of nutrients in order to understand the impact on weed flora. Results of the study conducted by Al-Tawaha *et al.*[31] on 10 varieties of barley subject to mineral fertilization with 100 kg ha^{-1} of diammonium phosphate (DAP) and 50 kg ha^{-1} of area showed that high grain yield was observed on varieties with high ability nutrients uptake. The same observation was made by Azeez and Adetunji[32] in maize crop where the best use of nitrogen has characterized genotypes with high uptake potential and 90 kg N ha^{-1} applied in urea form helped to increase grain yield of the culture and its competitiveness against weeds. Observation backed by Aminpanah *et al.*[33] who reported that the canola crop (*Brassica napus* L.) is less competitive in 0 kg N ha^{-1}, slightly competitive at 100 kg N ha^{-1} and more competitive at 200 kg N ha^{-1} against weeds. This ability is not observed in all genotypes whose yields are not similar. This opinion is complemented by Saberali *et al.*[34] in common bean crop. Different nitrogen rates 0-200 kg N ha^{-1} applied to semi-erected variety allowed to ensure a good control of *Amaranthus retroflexus* and get a high production, unlike the erected variety receiving from 0-140 kg N ha^{-1}. The competitiveness of *Amaranthus retroflexus* extends to many cultures, this opinion was supported by Blackshaw and Brandt[35] who emphasized his high ability in the nitrogen uptake in wheat crop resulting in an important increase to its above ground biomass in proportion to each addition of nitrogen doses 60, 120 and 240 mg N g^{-1}. Such observation was made on *Abutilon theophrasti* in association with maize[36].

In a comparative study of effects of composted organic amendments cassava peels, sawdust, corn stalks, leaves and dung hen with 900 and 400 kg ha^{-1} NPK 15-15-15 on *Tithonia diversifolia* and *Tridax procumbens* led by Adesina *et al.*[37] on tomato crop (*Lycopersicon lycopersicum* UC82B var). It was highlighted during two years of experience an increase in the density and biomass of weeds similar to unamended treatments because the mineral manure stimulate seed germination and regrowth, unlike organic amendments composted.

In maize crop, Khan *et al.*[38] showed response of weeds to macronutrients N, P and K applied in simple or compound form. The high grain yield w as induced by the NP form. As for the degrees of densities of these species; *Cyperus rotundus*, *Leptochloa* sp., *Echinochloa crus-galli*, *Sorghum halepense*, *Cynodon dactylon*, *Digitaria sanguinalis*, *Convovulvus arvensis*, *Amaranthus viridis* and *Digera muricata* and *Portulaca oleraceae*, they are as following N>NPK NP>P>NK>K>PK. However, the study by Tang *et al.*[39] showed that the formula of balanced fertilizer (NPK) has significantly reduced the density of four species of invasive weeds of wheat crop; *Galium aparine* L., *Veronica persica* Poir, *Viciasativa* L. and *Geranium carolinianum* L. compared to binary formulations NP, NK or PK which induced a high density of these species. Similar results were revealed by Iyagba *et al.*[40] in okra crop (*Abelmoschus esculentus* L. var NHAe 47-4) in Nigeria only 200 kg ha^{-1} of NPK were enough to increase the fruit yield and keep weeds at a low threshold of biological harmfulness.

Always on the same track on common bean crop nutrient appication in simple form or 50 kg ha^{-1} P_2O_5 and 50 kg N ha^{-1} (ammonium nitrate) and compound (NP, NK, PK and NPK) at sowing moment increased high density of *Solanum nigrum, Bidens pilosa* and *Galisonga parviflora* but the opposite trend was recorded in plots treated with 60 kg ha^{-1} K_2O[41].

Unlike previous results, other studies have shown that a soil rich in phosphorus and nitrogen, only 10-20 kg P ha^{-1} were enough to make the common bean very competitive with weeds[42,43].

Effects of fertilization-herbicides on weeds and crops: The IPM is a technique including a combination of several methods of weed control for sustainable management and further reducing the amount of pesticides and fertilizers[44,45]. In this case, it is the direct control of weeds or spread their bodies by the herbicides applied either pre-emergent or post-emergent treatments that retard their growth and mineral or organic fertilizer whose main objective is to promote crop growth by making it more competitive.

Herbicide effects on flora and soil seed stock: Processing of pre-emergence or pre-sowing, once applied herbicides reach the ground, they are adsorbed to soil colloids and the passive phenomenon of water by soaking the seeds regulated by the nature of the seed coat, the herbicide will penetrate the seed germination physiology to disrupt or inhibit the recovery of stolons, rhizomes and tubers etc.[46,47]. While, in post-emergent treatment there is a residual action low or nil as their efficiency is important especially at the time of application. In general, herbicide does not master a single plant species but several at different levels depending on the sensitivity of active ingredient[48].

Indeed, herbicides once mixed together with mineral or organic fertilizers may not induce the expected effects on both the culture of weeds, this depends on several factors including the physical and chemical properties of soils of active ingredients, application times and the nature of the fertilizer the type of weeds etc.

Furthermore, most herbicides containing radicals derived from urea have a double advantage whose action on the weeds and to some extent also on crops. One case is that raised by Soltani and Saeedipour[49] revealed that graminaceous herbicide effect and the remarkable increase in grain yield of wheat crop after a combination with ammonical nitrogen on silty clay soil.

In maize production, grain yield increases after application of 3% urea as NPK (160-80-50) in combination with 1125 g a.i ha^{-1} (Foramsulfuron isoxadifen-ethyl) post-emergence having allowed to reduce the density of three invasive species; *Trianthema portulacastrum* and *Cyperus rotundus* and *Coronopus didymus*[50].

Although, concerning other barley crop, it was reported that there is a synergy created by foramsulfuron 0.06 kg a.i ha^{-1} in the presence of nitrogen 50 kg ha^{-1} to ensure good control of *Convolvulus arvensis* L., *Amaranthus retroflexus* L. and *Physalis alkekengii* L. because beyond 50 kg N ha^{-1} there is increased density of these three species[51].

The application in post-emergence Mustang 306SE herbicide (1 L ha^{-1}) on oat crop has substantially reduced the density of dicotyledonous, unlike the case where it is mixed either fertilizer foliar spray insol 3 alone or in combination with Folicare 18-18-18[52]. Futhermore, Mick *et al.*[53] on bio fortified common bean crop (var prelon) argued that although, post-emergent glyphosate SL480 g a.i L^{-1} was employed at pre-sowing on ferralsol at 1.5, 3 and 4.5 L ha^{-1} and this with 200 kg ha^{-1} of NPK 10-20-10, 17-17-17 and 14-18-18 not any glyphosate dose allowed to control weeds or increase crop grain yield except 200 kg ha^{-1} of NPK 10-20-10. However, it was revealed the efficacy of certain post-emergence molecules applied at pre-sowing. For example, maize grain yield gain and better control of *Echinocloa crus-galli, Sorghum halepense*, *Cynodon dactylon*, *Digera muricata* and *Portulaca oleracea*, *Convolvulus arvensis* et *Cyperus rotundus* was induced by atrazine 1 kg a.i ha^{-1} and 160 kg N ha^{-1} compared to stomp 0.75 kg a.i ha^{-1} subject to same conditions and 2.4 D-72 (ester) 0.80 a.i kg ha^{-1} applied in post-emergence or 25 days after sowing[54].

Ellis-Jones *et al.*[13] also showed that atrazine does not lose its effectiveness on weeds when combined with other molecules as atrazine+metolachlor (2.6 kg a.i ha^{-1}) and atrazine+acetochlor+terbuthylazine (2.8 kg a.i ha^{-1}) that allowed increase significantly maize grain yield as when it combines the effects of 6 t ha^{-1} of chicken manure buried in soil 14 days before sowing.

This view is consistent with that issued by Mick *et al.*[55] in common bean culture that reveals compatibility during pre-sowing treatment of atrazine which 3 L ha^{-1} associated with 3 L ha^{-1} paraquat on ferralsol. In addition to corn, it was reported by Mick *et al.*[56] in treatment post-emergence atrazine 3 L ha^{-1} acetochlor associated with 3 L ha^{-1} does not ensure good weed control and do not increases the crop seed yield.

How to understand herbicide-soil interactions on the fate of active ingredient? According to Mamy[57], the decrease of the effectiveness of some herbicides once reached the ground would be governed by the type of soil that influences their adsorption to soil colloids. Moreover, Flogeac[58] emphasizes the nature of the molecule in adsorption process. Thus, anionic herbicides such as triazines and carbamates have a low adsorption capacity to the soil colloids while, cationic herbicides such as paraquat, diquat and some organophosphates will be strongly retained. However, for certain herbicides combined with fertilization, their effectiveness is likely in the presence of low efficiency weeds in nutrient uptake, because Modhej and Kaihani[59] revealed that the ineffectiveness of some herbicides due to increasing nitrogen rates (urea) 50, 100, 150 and 250 kg N ha^{-1} that made weeds stronger by strengthening their defense systems.

The rotation of herbicide molecules and splitting of fertilizer were found as palliative practices among others concerning the ineffectiveness of certain active substances in the weed control because the study conducted by Sheibani and Ghadiri[60] proved it after oilseed rape rotation

(*Brassica napus* L.) wheat, it was reported that splitting nitrogen (urea) which 304 kg N ha^{-1} at a rate of 152 kg N ha^{-1} in sowing phase and 152 kg N ha^{-1} in productive phase combined with post-emerging herbicides significantly reduced seed viability in stock from 0-30 cm deep including, Wheat 21 g a.i ha^{-1} iodosulfuron-methyl-sodium plus mesosulfuron-methyl-sodium reduced seed around 53-73% and for Oilseed rape (*Brassica napus* L.) 108 a.i ha^{-1} of haloxyfop (R) methylester have controlled the seed around 40-43%.

From the foregoing, The effects of mineral or organic fertilization would increase weed pressure either by strengthening the growth of seedlings present at the time of application or by the stimulating seed germination from seed stock of the past growing season. This can be seen most especially in marginal soils, case of tropical soils where one seeks to improve productivity by bringing amendments[61]. Furthermore, the chemical composition of organic and inorganic amendments proved to be a decisive factor on growth and development of plants[62].

Therefore, nitrogen from its presence in the balanced form represented by the three major elements (NPK) or binary forms NP and NK, it should be noted that the form of nitrate (NO_3^-), urea ($CO (NH_2)_2$) and ammonium (NH_4^-). Nitrogen has proven to be one of macro nutrients which makes some weed species more competitive to affect the culture.

CONCLUSION

Physico-chemical properties of soils, application moments and compatibility of active ingredients are determining factors of fertilizer and herbicide efficiency. Sustainable management of weeds by fertilization alone or combined to herbicides remains an effective technical route especially, for organic or inorganic amendments taking into account the type, quantity, storage methods and application moments. This holds also true for herbicides except factors discussed above, their effectiveness depends on the physico-chemical properties of soils and the predisposition of several active ingredients to be able to combine and widen the spectrum of action that the active ingredients are characterized by different levels of weed control or spread their organs. But, some herbicides especially containing an urea radical further phytocide actions, they reinforce the action of nitrogen fertilizers and promote crop growth. For the IPM program (fertilizers and herbicides) more sustainable, it would be wise to involve other techniques such as crop rotation, sowing densities, sowing dates, crop association and eventually the choice of genotypes tolerating low soil fertility or high competitive capacity of weed in uptaking and using nutrients.

SIGNIFICANT STATEMENT

Beyond the plant already established in the habitat, according to fertilization could influence the activation or inhibition of seed stock germination from previous years especially stimulus such as light, changes in temperature and rainfall are added.

This study brings answers to following question:

- Is fertilization an adapted weed management mode in Lubumbashi?
- Are herbicides application an effective method for weed management in Lubumbashi?

REFERENCES

1. Hassannejad, S. and S. Navid, 2013. Correlation between weeds and crops. Int. J. Biosci., 3: 117-124.
2. M'Biandoun, M. and J.P.O. Bassala, 2007. Savoir paysan et fertilite des terres au Nord-Cameroun. Cahiers Agricultures, 16: 185-197.
3. De Carvalho, S.J.P. and P.J. Christoffoleti, 2008. Competition of *Amaranthus* species with dry bean plants. Sci. Agric., 65: 239-245.
4. Das, T.K. and N.T. Yaduraju, 1999. Effect of weed competition on growth, nutrient uptake and yield of wheat as affected by irrigation and fertilizers. J. Agric. Sci., 133: 45-51.
5. Andreasen, C. and I.M. Skovgaard, 2009. Crop and soil factors of importance for the distribution of plant species on arable fields in Denmark. Agric. Ecosyst. Environ., 133: 61-67.
6. Smith, R.G., D.A. Mortensen and M.R. Ryan, 2010. A new hypothesis for the functional role of diversity in mediating resource pools and weed-crop competition in agroecosystems. Weed Res., 50: 37-48.
7. Chauhan, B.S. and S.B. Abugho, 2013. Fertilizer placement affects weed growth and grain yield in dry-seeded rice (*Oryza sativa* L.) systems. Am. J. Plant Sci., 4: 1260-1264.
8. Bajwa, A.A., Ehsanullah, S.A. Anjum, W. Nafees, M. Tanveer and H.S. Saeed, 2014. Impact of fertilizer use on weed management in conservation agriculture-a review. Pak. J. Agric. Res., 27: 69-78.
9. Leblanc, M.L., D.C. Cloutier, G.D. Leroux and C. Hamel, 1998. [Factors involved in emergence of weeds in the field]. Phytoprotection, 79: 111-127.
10. Murphy, C.E. and D. Lemerle, 2006. Continuous cropping systems and weed selection. Euphyta, 148: 61-73.

11. Mick, A.B.L., M. Alal, E.O. Augustin, I.T. Meschac, I.M. Maki, K.K. Karine and K.L. Antoine, 2015. [Inventory of weeds associated with common bean culture (*Phaseolus vulgaris*) as a guide in a weeding program-farm in the hinterland of Lubumbashi DR Congo]. Int. J. Innov. Applied Stud., 10: 678-686, (In French).
12. Mick, A.B.L., B.A. Bibich, M. Alal, E.O. Augustin and I.T. Meschac *et al*., 2015. [Impacts of two methods of weeding in the protection and production of three varieties of common bean (*Phaseolus vulgaris* L.) grown in Lubumbashi, DR Congo]. Int. J. Innov. Scient. Res., 14: 62-69, (In French).
13. Ellis-Jones, J., S. Twomlow, T. Willcocks, C. Riches, H. Dhliwayo and M. Mudhara, 1993. Conservation Tillage/Weed Control Systems for Communal Farming Areas in Semi-Arid Zimbabwe. In: Brighton Crop Protection Conference 1993: Weeds, BCPC (Ed.). Vol. 3, British Crop Protection Council, Alton Hampshire, UK., ISBN-13: 978-0948404702, pp: 1161-1166.
14. Mahadi, M.A., 2014. Growth, nutrient uptake and yield of maize (*Zea mays* L.) as influenced by weed control and poultry manure. Int. J. Sci. Nat., 5: 94-102.
15. Di Tomaso, J., 1995. Approaches for improving crop competitiveness through the manipulation of fertilization strategies. Weed Sci., 43: 491-497.
16. Sweeney, A.E., K.A. Renner, C. Laboski and A. Davis, 2008. Effect of fertilizer nitrogen on weed emergence and growth. Weed Sci., 56: 714-721.
17. Pourreza,J., A. Bahrani and S. Karami, 2010. Effect of nitrogen fertilization application on simulating wheat (*Triticum aestivum*) yield loss caused by wild oat (*Avena fatua*) interference. Am.-Eurasian J. Agric. Environ. Sci., 9: 55-61.
18. Agenbag, G.A. and O.T. de Villiers, 1989. The effect of nitrogen fertilizers on the germination and seedling emergence of wild oat (*A. fatua* L.) seed in different soil types. Weed Res., 29: 239-245.
19. Gallandt, E.R., 2006. How can we target the weed seedbank? Weed Sci., 54: 588-596.
20. Davis, A.S., 2007. Nitrogen fertilizer and crop residue effects on seed mortality and germination of eight annual weed species. Weed Sci., 55: 123-128.
21. Chee-Sanford, J.C., M.M. Williams II, A.S. Davis and G.K. Sims, 2006. Do microorganisms influence seed-bank dynamics? Weed Sci., 54: 575-587.
22. Alcoz, M.M., F.M. Hons and V.A. Haby, 1993. Nitrogen fertilization timing effect on wheat production, nitrogen uptake efficiency and residual soil nitrogen. Agron. J., 85: 1198-1203.
23. Paolini, R., M. Principi, R.J. Froud-Williams, S. del Puglia and E. Biancardi, 1999. Competition between sugarbeet and *Sinapis arvensis* and *Chenopodium album*, as affected by timing of nitrogen fertilization. Weed Res., 39: 425-440.
24. Soares, M.R.S., A.C.A. Neto, A.R. Sao Jose, A.D. Cardoso and O.M. Morais *et al*., 2015. Weed dry mass accumulation in response to the application of NPK fertilizers in cassava crop. Afr. J. Agric. Res., 10: 3596-3606.
25. Kumar, M., D.K. Kundu, A.K. Ghorai, S.P. Mazumdar and M.R. Naik, 2015. Weed density and diversity in jute under long-term experiment in jute-rice-wheat cropping system. Indian J. Weed Sci., 47: 16-20.
26. Douville, Y., 2002. Prevention des mauvaises herbes: Grandes cultures. Technoflora, desMerisiers, Becancour, Canada, pp: 1-24. https://www.agrireseau.net/agriculturebiologique/documents/slv09-108[1].pdf
27. Gana, A.K., 2009. Evaluation of the residual effect of cattle manure combinations with inorganic fertilizer and chemical weed control on the sustainability of chewing sugarcane production at badeggi southern Guinea Savanna of Nigeria. Middle-East J. Scient. Res., 4: 282-287.
28. Mahadi, M.A, S.A. Dadari, B. Tanimu, N.C. Kuchinda, A.I. Sharifai and M.S. Bature, 2012. Effects of weed control and cow dung manure on growth indices of quality protein maize. Bayero J. Pure Applied Sci., 5: 148-155.
29. Jiang, M., X.P. Shen, W. Gao, M.X. Shen and Q.G. Dai, 2014. Weed seed-bank responses to long-term fertilization in a rice-wheat rotation system. Plant Soil Environ., 60: 344-350.
30. Huang, S., X. Pan, Y. Sun, Y. Zhang, X. Hang, X. Yu and W. Zhang, 2013. Effects of long-term fertilization on the weed growth and community composition in a double-rice ecosystem during the fallow period. Weed Biol. Manage., 13: 10-18.
31. Al-Tawaha, A.R.M., M.A. Turk, K.D. Lee, W.J. Zheng, M. Ababneh, G. Abebe and I.W. Musallam, 2005. Impact of fertilizer and herbicide application on performance of ten barley genotypes grown in Northeastern part of Jordan. Int. J. Agric. Biol., 7: 162-166.
32. Azeez, J.O. and M.T. Adetunji, 2007. Nitrogen-use efficiency of maize genotypes under weed pressure in a tropical Alfisol in Northern Nigeria. Tropicultura, 25: 174-179.
33. Aminpanah, H., F. Rasouli and S. Firouzi, 2012. Effect of nitrogen rate on competition between canola (*Brassica napus* L.) cultivars and their natural weed populations. Thai J. Agric. Sci., 45: 213-219.
34. Saberali, S.F., S.A.M. Modarres-Sanavy, M. Bannayan, M.A. Baghestani, H.R. Mashhadi and G. Hoogenboom, 2012. Dry bean competitiveness with redroot pigweed as affected by growth habit and nitrogen rate. Field Crops Res., 135: 38-45.
35. Blackshaw, R.E. and R.N. Brandt, 2008. Nitrogen fertilizer rate effects on weed competitiveness is species dependent. Weed Sci., 56: 743-747.
36. Barker, D.C., S.Z. Knezevic, A.R. Martin, D.T. Walters and J.L. Lindquist, 2006. Effect of nitrogen addition on the comparative productivity of corn and velvetleaf (*Abutilon theophrasti*). Weed Sci., 54: 354-363.

37. Adesina, G.O., O.A. Olaniyan, M.A. Ojo and W.B. Akanbi, 2014. Comparison of different composts for weed suppression ability and tomato production in Ogbomoso, Nigeria. Int. J. Agric. Crop Sci., 7: 569-577.
38. Khan, M.A., S. Kakar, K.B. Marwat and I.A. Khan, 2013. Differential response of *Zea mays* L. in relation to weed control and different macronutrient combinations. Sains Malaysiana, 42: 1395-1401.
39. Tang, L., K. Wan, C. Cheng, R. Li and D. Wang *et al*., 2014. Effect of fertilization patterns on the assemblage of weed communities in an upland winter wheat field. J. Plant Ecol., 7: 39-50.
40. Iyagba, A.G., B.A. Onuegbu and A.E. Ibe, 2013. Growth and yield response of okra (*Abelmoschus esulentus* (L.) Moench) to NPK fertilizer rates and weed interference in South-Eastern Nigeria. Int. Res. J. Agric. Sci. Soil Sci., 3: 328-335.
41. Ugen, M.A., H.C. Wien and C.S. Wortmann, 2002. Dry bean competitiveness with annual weeds as affected by soil nutrient availability. Weed Sci., 50: 530-535.
42. Gidago, G., S. Beyene and W. Worku, 2011. The response of haricot bean (*Phaseolus vulgaris L.*) to phosphorus application on Ultisols at Areka, Southern Ethiopia. J. Biol. Agric. and Healthcare, 1: 38-49.
43. Turuko, M. and A. Mohammed, 2014. Effect of different phosphorus fertilizer rates on growth, dry matter yield and yield components of common bean (*Phaseolus vulgaris* L.). World J. Agric. Res., 2: 88-92.
44. Blackshaw, R.E., L.J. Molnar and F.J. Larney, 2005. Fertilizer, manure and compost effects on weed growth and competition with winter wheat in Western Canada. Crop Protect., 24: 971-980.
45. O'Donovan, J.T., R.E. Blackshaw, K.N. Harker, G.W. Clayton and J.R. Moyer *et al*., 2007. Integrated approaches to managing weeds in spring-sown crops in western Canada. Crop Protect., 26: 390-398.
46. Eke, A.O. and O.U. Okereke, 1990. Seed germination and growth of *Eleucine indica* and *Euphorbia heterophylla* as influenced by depth of planting and glyphosate. Ghana J. Agric. Sci., 20-23: 77-83.
47. Watkin, E.M. and G.R. Sagar, 1972. Effect of paraquat on seed germination. Weed Res., 12: 195-198.
48. Berti, A. and M. Sattin, 1996. Effect of weed position on yield loss in soyabean and a comparison between relative weed cover and other regression models. Weed Res., 36: 249-258.
49. Soltani, F. and S. Saeedipour, 2015. Efficacy evaluation of some herbicides and different nitrogen levels for weed management and yield attributes in wheat. WALLIA J., 31: 39-43.
50. Nadeem, M.A., R. Ahmad, M. Khalid, M. Naveed, A. Tanveer and J.N. Ahmad, 2008. Growth and yield response of autumn planted maize (*Zea mays* L.) and its weeds to reduced doses of herbicide application in combination with urea. Pak. J. Bot., 40: 667-676.
51. Najafi, B. and H. Ghadiri, 2012. Weed control and grain yield response to nitrogen management and herbicides. J. Biol. Environ. Sci., 6: 39-47.
52. Andruszczak, S., E. Kwiecinska-Poppe, P. Kraska and E. Palys, 2010. The effect of different agrotechnical levels on weed infestation in crops of Naked and Husked varieties of oat (*Avena sativa* L.). Acta Agrobotanica, 63: 207-213.
53. Mick, A.B.L., M. Alal, E.O. Augustin, M. Munung, I.T. Meschac and K.L. Antoine, 2014. [The combination of mineral fertilizer and herbicide on Ferralsol is it an alternative to increase the yield of common bean (*Phaseolus vulgaris* L.) by weed management in Lubumbashi, DR Congo?]. Int. J. Innov. Applied Stud., 9: 1765-1772, (In French).
54. Khan, N., N.W. Khan, S.A. Khan, M.A. Khan and K.B. Marwat, 2012. Combined effect of nitrogen fertilizers and herbicides upon maize production in Peshawar. J. Anim. Plant Sci., 22: 12-17.
55. Mick, A.B.L., B.T. Kasu-Bandi, M.K. Kabemba, L.K. Kidinda and A.K. Lubobo, 2015. Adventitious flora and its behavior in common bean (*Phaseolus vulgaris* L.) cultivated under different weed management methods in the upper Katanga, DR Congo. Am. J. Plant Nutr. Fertil. Technol., 5: 85-95.
56. Mick, A.B.L., T.K. Felix, K.K. Laurent, M.K.J. Paul, T.T. Dominique, N.K. Luciens and B.L. Louis, 2015. [The combination of herbicides, an expensive option in the fight against weeds in maize crop in Lubumbashi (DR Congo)]. Int. J. Innov. Applied Stud., 12: 140-147, (In French).
57. Mamy, L., 2004. Comparaison des impacts environnementaux des herbicides a large spectre et des herbicides selectifs: Caracterisation de leur devenir dans le sol et modelisation. Ph.D. Thesis, Institut National Agronomique Paris-Grignon, France.
58. Flogeac, K., 2004. Etude de la capacite de retention de produits phytosanitaire par deux solides modeles des sols. Influence de la presence des cations metalliques. Ph.D. Thesis, Universite de Reims Champagne-Ardenne, France.
59. Modhej, A. and A. Kaihani, 2013. Effect of nitrogen fertilizer and herbicides on weed control and wheat grain yield under subtropical conditions. Int. J. Biosci., 3: 73-83.
60. Sheibani, S. and H. Ghadiri, 2012. Effect of split nitrogen fertilization and herbicide application on soil weed seed bank in wheat (*Triticum aestivum* L.) and oilseed rape (*Brassica napus* L.) rotation. J. Biol. Environ. Sci., 6: 25-33.
61. Major, J., C. Steiner, A. Ditommaso, N.P.S. Falcao and J. Lehmann, 2005. Weed composition and cover after three years of soil fertility management in the central Brazilian Amazon: Compost, fertilizer, manure and charcoal applications. Weed Biol. Manage., 5: 69-76.
62. Ali, K., M. Arif, W. Ullah, Abdullah and W. Ahmad *et al*., 2015. Influence of organic and inorganic amendments on weeds density and chemical composition. Pak. J. Weed Sci. Res., 21: 47-57.