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A Review of Critical Period of Weed Competition in Cassava Fields

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Abstract:
Weed species compete with crop on the field for water, light, nutrients, space and even agronomic attention. If this competition is not checked promptly, it consequently leads to poor output or reduction of yields. The weeding regime actually exert much impact on overall cassava output because it is a very poor competitor especially at its early stage of development. Critical period of weed competition in cassava fields were studied in many parts of the tropics where cassava is an economic arable crop with diversified results. These results were reviewed and they were observed critically to have common focus even though the researchers' approaches differ. It is crystal clear that critical period of weed competition needs be determined to decide on when best to effect control measure for the best result and thereby prevent the possible consequential cassava yield loss. The critical period of weed competition is therefore identified as the critical period of weed control.

Keywords: *Cassava (Manihot esculenta Crantz), critical period, weed competition, weed control*

1. Introduction

Cassava (*Manihot esculenta* Crantz) is a root/tuber crop belonging to the *Euphorbiaceae* family of plant. It is cultured for its root tuber which is embedded with starch. Cassava is a major source of carbohydrates for more than 200 million people, especially in Africa and to some extent in Asia and Latin America (Melifonwu, 1994). Although the crop originated from Brazil, Latin America it is grown today all over the world majorly in West Africa, North America, Asia and the pacific. Africans especially Nigerians are the chief producers and major consumers of the crop in the world (Bruinsma, 2003).

According to Johanns & Contiero (2006), Cassava presents a perennial cycle and has many advantages over other arable crops, such as the possibility of obtaining high productivity, high tolerance to drought and degraded soils or acids and easy adaptation to environments where the planting of other crops would be more risky, playing an important role in human and animal foods and in the industrial processing of flour and starch. Cassava producers 'efforts to meet the increasing demand for the crop globally is being impeded by the menace of weeds infestation and their competition with the crop for production resources.

Weeds are plants growing in arable fields or lawns voluntarily and are causing harm to the cultured plant or other cohabitants. They are therefore described as unwanted plants because they grow where they are not desired to stand even if they are at times useful and so described by Gorsi et al., (1991) as a plant out of place. Weed is a pest because it is not just out of place or unwanted but adversely compete with the crop for sunlight, water, air, nutrients (Szumigalski & Van Acker, 2005) and even space (Mortensen et al., 2012). The competition between weeds and cassava crop for the limited production resources adversely affect the health, vigour, quality and output of the crop. Most crop failure recorded in cassava fields are due to the menace of weeds infestation and competition. The quantum of yield loss in cassava due to weed competition is dependent on the time of planting, the time of emergence of weeds on the field, weed population density and abundance, competitive ability of each weed species; crop factors such as time of planting, time of germination, growth rate, stage of crop development, crop canopy and crop competitive ability as well as cultural and agronomic practices such as cropping systems and weed management practices (Valadatilde et al., 2013). In their own words, Carvalho & Christoffoleti (2008), stated that 'weeds compete with field crops mainly for water, light,, nutrients and this competition among other factors, a function of the occurrence of weed density, and the intrinsic competitive ability of each vegetal species.'

Available data from several countries where cassava production is of high economic strata, especially in the humid and sub-humid African tropics, Brazil and India, revealed that weed flora compete strongly with the crop that if not promptly and adequately checked

could cause total yield loss or crop failure (Albuquerque et al., 2008; Melifonwu, 1994). Therefore in order to save cassava production from the menace and consequences of weeds competition, and in order to maximize yield from cassava production function, there is ardent need to understand the weeds, how they infest arable lands and when they are at their peak of competition with the crop (Onochie, 1975; Szumigalski & Van Acker, 2005). This discourse is the prime motive of studying the critical period of weed competition in cassava fields.

This paper is therefore intended to review past discourses of this critical period of weed competition in cassava fields with the aim of bringing to limelight the consensus of various authors on determining the critical period of weed control in order to curb the adversity and menace of weed flora in cassava fields.

2. Critical Period of Weed Competition in Cassava Fields

The concept of critical period of weed competition were defined variously by different authors but the focal point is the period of possible yield loss if control measures are not taken at the particular period of weed competition with the crop on the field. 'it is a span of time between that period after seeding or emergence when weed competition does not reduce crop yield and the time after which weed competition will no longer reduce crop yield' (Zimdahl et al.,1988). He rather referred to it as 'critical period of weed control'. Cassava like many other arable crops in the tropics, is highly susceptible to infestation and competition with weed species on the fields, which may consequentially lead to yield losses as much as 90% (Albuquerque et al., 2008) or total crop failure. This competition occurs at different stages of the life cycle of the crop and as such it is more impactful at one stage than another. In order to minimize yield loss, the weeds must be checked at the most impactful stage of weed competition.

This stage of weed competition is referred to as critical period of weed competition (CPWC). It is described as the time frame by which the presence of weed species in an arable field affect the cohabiting crop or crops adversely so that if not checked promptly and properly could lead to loss of crop yields as much as affecting the crop quality (Nazarko et al., 2005; Swanton et al., 2008), Weed competition is said to be critical when it does not only affects the crop by competing for sunlight, water, air, nutrients and space, but also detrimentally affects the crop's health, vigour, growth and productivity (Knezevic et al., 2002). Critical Period of Weed Competition is the "window" in the crop growth cycle during which weeds present around the crop must be controlled to prevent unacceptable yield losses (Knezevic et al., 2002). In order to plan appropriate and economical management strategies that are also environmental friendly with little or no residual effects on the crop, the knowledge of the critical period of weed competition is essentially required (Carvalho & Christoffoleti, 2008).

3. Critical Period for Weed Control in Cassava Fields

According to Harker et al (2001), knowledge of the critical periods of weed competition in cassava fields will help us to decide on appropriate time and management strategies for best results, avoiding economic wastages and ensuring environmental friendliness. He referred to this period as **critical period for weed control** in cassava fields by which if the weeds are not checked promptly and adequately, may cause cassava yield loss. That is, an attempt to determine critical period of weed of competition is a determination of critical period for weed control and the third step in weed management principle after identification of weeds and establishment of facts on the relationship between yield loss and weed competition.

Available data from previous studies from several cassava producing regions especially in Brazil, India and Nigeria revealed that weed species compete so strongly with cassava plants that if they are not promptly and adequately checked could cause total yield loss. However the 'windows' of critical weeds competition needs be ascertained. Onochie (1975) observed that the critical period of weed competition in cassava fields in Nigeria as 8-12 weeks after planting by which weed control is necessary in order to avoid significant yield loss. He observed 40-100 % yield loss in several fields of cassava mono-cropped or mixed-cropped, as a result of the adverse effect of weed competition. According to him, the most damaging effect of weeds on cassava yields were done by the broadleaved species and the damage were noted at the early canopy formation and early tuberization stages (8-12 weeks after planting) and a less damaging effect from sixteenth weeks after planting till maturity.

In a study carried out in Umudike National Root Crop Research Institute, South-Eastern Nigeria, (Akobundu, 1980; Melifonwu, 1994) recognized two distinct windows of critical weed competition in cassava fields; 2-6 weeks after planting and 8-12weeks after planting. According to them the first window is the period of competition for dominance while the second window is the most critical period by which competition is highly disadvantageous to the crop. If weeds are not checked by this period they may cause total crop failure or 100% yield loss (Bajwa, 2014).

In an experiment carried out by Costa et al (2013) on weed interference periods in the 'Fecula Branca' cassava in western Parana, they observed that the coexistence of the cassava with weeds caused significant differences when compared to the weed free fields productivity. 'The weed interference caused a decrease in root production and, consequently in production of starch'. An effort to determine the critical period of cassava – weed competition is very essential for the right management approach in promptness and efficiency especially, for the recent adoption of herbicides technology in cassava weed management (Nweke, 2004). The optimum weed control system is usually determined on the basis of the critical periods of weed competition (Knezevic et al., 2002).The correlation of yield loss in cassava fields with weed competition is most significant at the critical period of weed competition. This period usually falls between the intervals of the length of time that field must be weed free for the crop to be able to resist the impact of the weeds and perform optimally and the length of time weeds take to establish to begin to affect the crop adversely (Ghosheh & Al-Shannag, 2000). Cassava plant is slower in germination and early growth rate than most tropical weed flora. It was observed from the previous study of competition between cassava and weed flora that the weed species took 2-3 days to emerge whereas cassava took 4-5 days. Most tropical weed flora are highly germinable and spread easily especially the broadleaved weed species. This

situation exposes the crop to early competition soon after planting. Some noxious weed flora like *Cascuta sp.* and *Mimosa spp.* affect the germination of cassava stems if clearance was not properly done. Some other weeds like the *Imperata cylindrica* affect cassava root storage by piercing through. These are two distinct stages of the crop life cycle. Some weed species with allele-chemicals in humid condition suppresses the germinability and germination rate of cassava stems or cuttings (Albuquerque et al., 2008) and thereby subject the seedlings to serious competition for the next 12-13 weeks of the plant's life cycle (Akobundu, 1997; Melifonwu, 1994; Nazarko et al., 2005). It therefore become imperative to study these periods as windows of critical competition so that effective control measures are necessary to ensure high yield of cassava roots rather than weeding throughout the entire life cycle of the crop which is tedious and time wasting. If herbicides were employed the crops and the environment is exposed to chemical hazards after every subsequent usage. Weed management at the critical periods of competition was considered to be the most effective in ensuring high productivity in quantity and quality of cassava, than weeding through the entire period of growth of the crop. (Onochie, 1975) recorded a very high roots yields in Nigeria (98%) with relatively less cost of production.

Melifonwu, (1994), observed that the first 4-8 weeks were found to be the most critical period of weed competition in a cassava fields during which control is highly essential to avoid yield loss. Weeds emerging after this period could be checked by the canopy of cassava plant or any other mixed crop stand on the field.

S/No.	Critical period (DAP)	Region (Country)	Author
1	28-84	SE, Nigeria	Onochie,1975
2	40-84	SE, Nigeria	Akobundu,1980
3	35-84	Ibadan, Nigeria	IITA,1990
4	20-60	Cameroun	Ambe et al.,1992
5	42-84	Umudike, Nigeria	Melifonwu,1994
6	28-70	Brazil	Albuquerque,2008
7	66-91	Canada	Costa et al., 2012

Table 1: Critical Periods of Weed Competition Observed in Cassava Fields

4. Rational for Observing Critical Period of Weed Competition in Cassava Fields

The botanical nature of cassava predisposes it to early infestation and submerging of the weed flora which usually emerges first and grow faster than cassava (Albuquerque et al., 2008). Most cassava weeds especially the broadleaved weeds have the same nature with the crop. This makes cassava a weak and poor competitor with such weeds. The second rational is that cassava is very sensitive to chemicals and as such excessive use of herbicide may jeopardize the life of the crop or exposes it to residual effects of chemicals or toxicity (Melifonwu, 1994). A knowledge of the critical period of weed competition helps us determine when best to adopt a control technology that will best decimate the population of weed flora in the field if not completely eradicable. According to Akobundu (1980), a timely applied chemical control at the critical period of weed competition is most effective with realistic results than continuous use of herbicides without target or the uncongenial and laborious manual hand/hoe weeding which is required 4-8 times to achieve results. Continuous use of chemicals exposes the crop and the environment to toxicity. Weeds may also develop resistance for chemicals use several times on a field. It is therefore very rational to establish the window of critical competition for critical control for timely application with reassuring result. It is also good to note that control measures applied after the expiration of the critical period is of less relevance to the productivity of the crop as the weeds would have succeeded in derailing the tuberization and consequently reducing the yield and the vigour of the root storage.

5. Conclusion

A knowledge of the critical period of weed competition is very essential for the right decision in management approach regarding its promptness and efficiency without hazards especially, for the recent adoption of herbicides technology in cassava weed management. The optimum weed control system is usually determined on the basis of the critical periods of weed competition. Critical period of weed control is economical, effective and result targeted with excellent environmental considerations. It is certain that the critical period of weed competition is the critical period of weed control. A period when control measures are best applicable after which they become less necessary.

6. References

i. Akobundu, I. O. (1980). Weed control in cassava cultivation in the subhumid tropics. International Journal of Pest Management, 26(4), 420–426.
ii. Akobundu, I. O. (1997). Weed science development in Nigeria yesterday, today and tomorrow. Nig. J. Weed Sci, 10, 61–70.
iii. Albuquerque, J. D., Sediyama, T., Silva, A. D., Carneiro, J. E. S., Cecon, P. R., & Alves, J. M. A. (2008). Interferência de plantas daninhas sobre a produtividade da mandioca (Manihot esculenta). Planta Daninha.
iv. Bajwa, A. A. (2014). Sustainable weed management in conservation agriculture. Crop Protection, 65, 105–113.
v. Bruinsma, J. (2003). World agriculture: towards 2015/2030: an FAO perspective. Earthscan.
vi. Carvalho, S. J. P. D., & Christoffoleti, P. J. (2008). Competition of Amaranthus species with dry bean plants. Scientia Agricola, 65(3), 239–245.
vii. Costa, N. V., Ritter, L., Peres, E. J. L., Silva, P. V., & Vasconcelos, E. S. (2013). Weed interference periods in the'Fécula

Branca'cassava. Planta Daninha, 31(3), 533–542.
viii. Ghosheh, H. Z., & Al-Shannag, H. K. (2000). Influence of weeds and onion thrips, Thrips tabaci (Thysanoptera: Thripidae), on onion bulb yield in Jordan. Crop Protection, 19(3), 175–179.
ix. Gorsi, S. Z., Shinwari, K., & M. Arshad. (1991). Preliminary Studies on weeds of rice fields of Rechna-Doab. Pakistan Journal of Science Research, 4, 62 – 68.
x. Harker, K. N., Blackshaw, R. E., & Clayton, G. W. (2001). Timing Weed Removal in Field Pea (Pisum sativum). 1. Weed Technology, 15(2), 277–283.
xi. Johanns, O., & Contiero, R. (2006). Efeitos de diferentes períodos de controle e convivência de plantas daninhas com a cultura da mandioca. Rev. Ciênc. Agronôm, 37(3), 326–331.
xii. Knezevic, S. Z., Evans, S. P., Blankenship, E. E., Van Acker, R. C., & Lindquist, J. L. (2002). Critical period for weed control: the concept and data analysis. Weed Science, 50(6), 773–786.
xiii. Melifonwu, A. A. (1994). Weeds and their control in cassava. African Crop Science Journal, 2(4), 519–530.
xiv. Mortensen, D. A., Egan, J. F., Maxwell, B. D., Ryan, M. R., & Smith, R. G. (2012). Navigating a critical juncture for sustainable weed management. BioScience, 62(1), 75–84.
xv. Nazarko, O. M., Van Acker, R. C., & Entz, M. H. (2005). Strategies and tactics for herbicide use reduction in field crops in Canada: a review. Canadian Journal of Plant Science, 85(2), 457–479.
xvi. Nweke, F. I. (2004). New challenges in the cassava transformation in Nigeria and Ghana. Intl Food Policy Res Inst.
xvii. Onochie, B. E. (1975). Critical periods for weed control in cassava in Nigeria. PANS Pest Articles & News Summaries, 21(1), 54–57.
xviii. Swanton, C. J., Mahoney, K. J., Chandler, K., & Gulden, R. H. (2008). Integrated weed management: knowledge-based weed management systems. Weed Science, 56(1), 168–172.
xix. Szumigalski, A., & Van Acker, R. (2005). Weed suppression and crop production in annual intercrops. Weed Science, 53(6), 813–825.
xx. Valadatilde, D., Santos, J. B., Carvalho, F. P., Silva, E. B., & Sebastiatilde, J. Concenccedil, G. (2013). Competitive capacity of cassava with weeds: Implications on accumulation of dry matter. African Journal of Agricultural Research, 8(6), 525–531.
xxi. Zimdahl, R. L., Moody, K., Lubigan, R. T., & Castin, E. M. (1988). Patterns of weed emergence in tropical soil. Weed Science, 603–608.