



## **Assessment of Weed Species Traits, Duration Taken from Germination to Flowering and Crop Affected on Farms in Kisii Central Sub County, Kisii County, Kenya**

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### **Abstract**

*Weed invasion is one of the greatest challenges affecting smallholder farming in Kenya. Timely and effective weed management needs knowledge on weed species traits and their nature of growth. This study aimed at assessment and documentation of weed species traits and time taken from germination to flowering for effective weed management. Ten plots were selected 1km equidistantly along a transect set across each of the eight randomly sampled sub-locations in the study area. In each plot, a 2m<sup>2</sup> portion was demarcated for monitoring weed species germination to flowering time. Botanical classification of weed species was carried out through examination of the foliage and reproductive regions with the aid of guide books. Weed species *G. parviflora* and *E. brachycephala* had the shortest duration to flowering of 4 weeks while *T. minuta* and *D. stramonium*, each had the longest flowering duration of 7 weeks. Majority (14) of the weed species were broadleaved while eight were narrow leaved weed species. Thirteen annual weed species were recorded while only nine species were perennial. Three weed species were grass, 2 sedges, 1 shrub and 16 herbs. Fourteen weed species were eudicot while only 8 were monocots. Four weed species were dispersed by insects while wind dispersal and animal dispersal had 9 weed species in each case. Most farms were infested by a variety of weed species which included *Pennisetum clandestinum*, *Oxalis latifolia*, *Cyperus rotundus*, *Amaranthus hybridus* and *Datura stramonium*. Weed species traits and interval from germination to flowering will aid forecast on successive weed invasions and thus guide farmers on the effective time of weed management measures such as adoption of integrated weed management practises to optimize crop production.*

**Keywords:** Shrub, Sedge, Eudicot, Smallholder Farmers, Kisii

### **INTRODUCTION**

According to Mahmoodi and A. Rahimi, (2009) and Oudhia (2004), weeds are plants which compete with arable crops for resources such as moisture, light, space and nutrients. Weeds are unfriendly as a consequence of their allelopathic, competitive, persistent and pernicious attributes (Zaman, Farrukh and Muhammed, 2011). KARLO, (2013) established that weeds are one of the major constraints to rice production in sub-Saharan Africa. According to Iyagba (2010), weeds that sprout three months after sowing pose great danger in crop production more than those that emerge later.

On most farms, weeding usually competes with other farm activities and is postponed to a later date. Farmers will not weed crops that are sown first until they complete the seedbed preparation and sowing of all other fields. Farmers prefer to go on planting to take

advantage of moisture in the soil (Makanganise and Mabasa, 1999). As in most plants, weed seeds are very vital in the growth cycle of annual or perennial weed species that reproduces through seed alone (Swanto et al., 2008). The competitiveness of weeds is often measured in terms of crop yield reduction per unit of weed population or biomass, and the yield reduction can vary greatly as a result of the weed species (Hassan et al., 2010).

Biological and ecological information, specifically germination ecology of a specific weed, is necessary to optimize weed control and maximize the efficiency of management tactics (Bhowmik, 1997). Allelochemicals are exhibited in all plant varieties besides tissues and are released into the soil rhizosphere through various mechanisms, such as degradation of residues, volatilization, and root exudation (Farooq et al., 2013). According to Macías et al., (2007), allelochemical structures and modes of action are varied and can provide room for the formulation of herbicides. Recent research suggests that allelopathic properties can render one species more invasive to native species and thus potentially detrimental to both agricultural and naturalized settings Nichols et al., 2015). In contrast, allelopathic crops further provide a leeway for the development of propagules which are greatly weed suppressive (Bajwa, 2014).

The ability to produce a huge number of minute seeds serves as a crucial weed survival mechanism towards weed eradication methods. According to Irri (2010), one plant of *Ludwigia octovalvis* (Onagraceae) is capable of producing 250,000 seeds and among the species within the family Cyperaceae, *Schoenoplectus juncooides* produces 82,098 seeds m<sup>-2</sup> (Leck and Schutz, 2003). After successful weed seed dispersal, the seeds may land onto the soil surface or be buried by different biotic and abiotic agents, thus forming a soil seed bank that forms a significant source of weeds in agro-ecosystems. Weed seed location in the soil seed bank influences germination, emergence and vertical seed distribution in the soil (Norsworthy and Oliveira, 2006).

Kisii Central Sub County is one of the regions that food crops are produced for both subsistence and commercial purposes (KNBS, 2019). The region is endowed with arable fertile soils and sufficient rains that favour both crops and weeds flourishing.

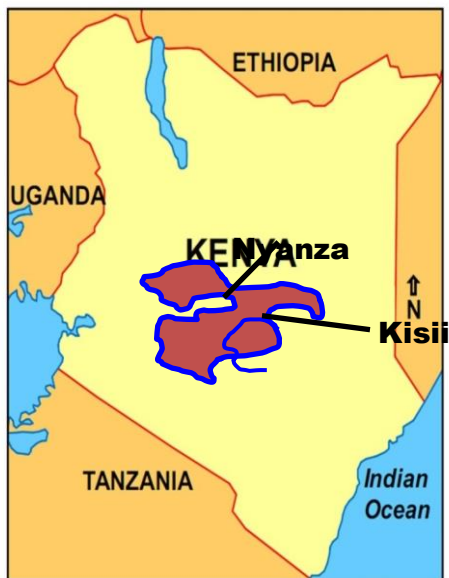
## MATERIALS AND METHODS

### Description of the study area

Kisii Central Sub County forms one of the nine Sub Counties of Kisii County in Southwest Kenya. Temperatures of the area ranges from 10°C to 30°C. According to the (KNBS, 2019), Kisii Central Sub County had a population of 588,000, however, with a growth rate of 3.6%, the population is ballooning over 700,000 (19% of whom inhabit urban regions). Kisii Central Sub County is one of the most densely populated Sub Counties in Kenya. The sub county has an area coverage of 317.4 Km<sup>2</sup>. Notably, as a result of the high population density, a large percentage of the land is utilized for intensive agricultural production.

The Land has been sub-divided among families, with the farms growing progressively smaller with an average farm being 15,000 m<sup>2</sup> in area; with an average of an eighth of an acre allocated for arable farming (MoA, 2017). Majority of farmers engage largely in subsistence and minimal commercial production. The land allocated for cash crop production in the study area is approximately 3,800ha while that for food crop production is about 12,500ha. Livestock production is characterized by dairy farming and local poultry

rearing (MoA, 2017) Agriculture employs an estimated 80% of the population either directly or indirectly and the estimated rural poverty is 30% with some areas having as high as 61% (MoA, 2016).



**Figure 1: Kisii County, Nyanza Province of Kenya, where the research was undertaken.**

*Source: Kisii county profile plan (18/3/2022)*



**Figure 2: Kisii Sub-County Regions in Kisii County where the research was done**

### Data Collection

Eight administrative sub-locations were randomly selected in the sub-county. Ten plots were selected at an interval of a kilometre along a transect laid across each of eight randomly selected sub-locations in the study area. In each plot, a 2m<sup>2</sup> portion was demarcated for monitoring weed species growth and time to flowering. After ploughing, weed emergency was monitored after a week and later on weekly basis for three months. Botanical identification of weed species was done through the analysis of both the vegetative and reproductive parts in reference to guide books besides making a comparison of the weeds with voucher specimens deposited at National Museums of Kenya. Plant taxonomists were also consulted to aid in the identification of weed species that were not identified in the farms.

### Data Analysis

Data on duration of weed species germination to flowering and weed species traits on the farms was subjected to one sample t-test analysis to compare the effect on mean number of durations of weed species germination to flowering and weed species traits respectively.

## RESULTS

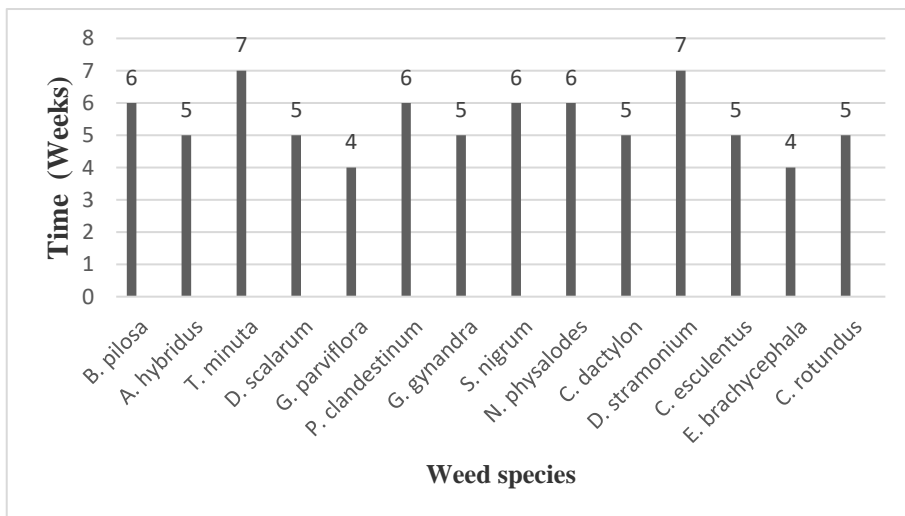
### Weed Species Duration of Germination to Flowering

The duration taken from weed germination to flowering of some weed species was monitored and recorded (Table 1). Weed species *G. parviflora* and *E. brachycephala* exhibited the relatively shortest duration to flowering of 4 weeks while *T. minuta* and *D. stramonium* each had the longest flowering duration of 7 weeks. Weed species germination to flowering duration was statistically significant ( $p < 0.05$ ) among weed species on the farms.

**Table 1: Weed species duration of germination to flowering**

Weed species	Germination to flowering duration (weeks)
Black jack ( <i>Bidens pilosa</i> )	6
Pigweed ( <i>Amaranthus hybridus</i> )	5
Mexican marigold ( <i>Tagetes minuta</i> )	7
Couch grass ( <i>Digitaria scalarum</i> )	5
Macdonald's eye ( <i>Galinsoga parviflora</i> )	4
Kikuyu grass ( <i>Pennisetum clandestinum</i> )	6
Spider flower ( <i>Gynandropsis gynandra</i> )	5
Black night shade ( <i>Solanum nigrum</i> )	6
Chinese lantern ( <i>Nicandra physalodes</i> )	6
Star grass ( <i>Cynodon dactylon</i> )	5
Thorn apple ( <i>Datura stramonium</i> )	7
Flat sedge ( <i>Cyperus esculentus</i> )	5
<i>Emilia brachycephala</i>	4
<i>Cyperus rotundus</i>	5

The duration taken from weed germination to flowering of some weed species was monitored and recorded as shown in Figure 1.



**Figure 1: Weed species duration of germination to flowering**

## Weed Species Traits

Weed species like *Pennisetum clandestinum* is a perennial narrow leaved grass with one cotyledon and its seeds are dispersed by wind while *Bidens pilosa* is an annual broad leaf weed, a eudicot herb which is dispersed by animals. *Digitaria scalarum* is a perennial grass with two cotyledons which is dispersed by wind while *Commelina benghalensis* is a perennial narrow leaved herb with one cotyledon and it is insect dispersed. *Galinsoga parviflora* is an annual broadleaved herb which is eudicot and wind dispersed as illustrated in Table 2. Weed species traits were statistically significant ( $p < 0.05$ ) among weed species on the farms.

**Table 2: Traits of weed species on farms**

Botanical name	Leaf type	Life Span	Habit	No. of Cotyledons	Mode of seed dispersal
<i>Pennisetum clandestinum</i>	Narrow	Perennial	Grass	Monocot	Wind
<i>Bidens pilosa</i>	Broad	Annual	Herb	Eudicot	Animal
<i>Digitaria scalarum</i>	Grass	Perennial	Grass	Monocot	Wind
<i>Commelina benghalensis</i>	Narrow	Perennial	Herb	Monocot	Insects
<i>Tagetes minuta</i>	Narrow	Annual	Herb	Eudicot	Animal/wind
<i>Galinsoga parviflora</i>	Broad	Annual	Herb	Eudicot	Wind
<i>Nicandra physalodes</i>	Broad	Annual	Shrub	Eudicot	Insects/wind
<i>Amaranthus hybridus</i>	Broad	Annual	Herb	Eudicot	Wind/animal
<i>Cynodon dactylon</i>	Narrow	Perennial	Grass	Monocot	Wind
<i>Solanum incanum</i>	Broad	Annual	Herb	Eudicot	Animal
<i>Gynandropsis gynandra</i>	Broad	Annual	Herb	Eudicot	Animal/wind
<i>Oxalis latifolia</i>	Broad	Annual	Herb	Eudicot	Wind
<i>Conyza banariensis</i>	Narrow	Annual	Herb	Monocot	Wind
<i>Datura stramonium</i>	Broad	Annual	Herb	Eudicot	Animal/wind
<i>Solanum nigrum</i>	Broad	Annual	Herb	Eudicot	Wind/insects
<i>Cyperus esculentus</i>	Grass	Perennial	Sedge	Monocot	Wind
<i>Emilia brachycephala</i>	Broad	Annual	Herb	Eudicot	Wind
<i>Pteridium aquilinum</i>	Narrow	Perennial	Herb	Monocot	Wind
<i>Crassocephalum vitellinum</i>	Broad	Perennial	Herb	Eudicot	Wind
<i>Leonotis mollissima</i>	Broad	Annual	Herb	Eudicot	Wind/animal
<i>Leucas martinicensis</i>	Broad	Annual	Herb	Eudicot	Wind/animal
<i>Physalis ixocarpa</i>	Broad	Annual	Herb	Eudicot	Animal
<i>Cyperus rotundus</i>	Narrow	Perennial	Sedge	Monocot	Wind
<i>Achyranthes aspera</i>	Broad	Perennial	Herb	Eudicot	Animal

Based on leaf type, majority (14) of the weed species were broadleaved, seven were narrow leaved while only one was grass. Classification on lifecycle, thirteen annual weed species were recorded while only nine were perennial. In terms of growth habit, 3 were grass, 2 sedges, 1 shrub and 16 herbs. On number of cotyledons, fourteen weed species were eudicot while only 8 were monocots. Based on mode of dispersal, only four weed species were dispersed by insects while wind dispersal and animal dispersal had 9 weed species in each case as illustrated in Table 3.

**Table 3: Summary of weed species traits**

Leaf type			Life span		Growth habit				No. of cotyledons		Mode of dispersal		
Narrow	Broad	Grass	Annual	Perennial	Herb	Shrub	Grass	Sedge	Mono-cot	Eudicot	Animal	Insect	Wind
7	14	1	13	9	16	1	3	2	8	14	9	14	9

**Crops Affected on the Farms**

Weed species such as *Pennisetum clandestinum*, *Oxalis latifolia*, *Cyperus rotundus*, *Amaranthus hybridus* and *Datura stramonium* occur in most cultivated crops such as cereals, legumes, brassicas, tea and pastures as illustrated in Table 4.

**Table 4: Crops affected on farms**

Common Name	Botanical Name	Local Name	Crops affected
Kikuyu grass	<i>Pennisetum clandestinum</i>	Esereti	Maize, tea, beans, coffee.
Mexican marigold	<i>Tagetes minuta</i>	Omotioki	Legumes, most cultivated crops.
Black jack	<i>Bidens pilosa</i>	Ekemogamogi	Most arable crops; cereals
Pigweed	<i>Amaranthus hybridus</i>	Emboga	Most arable crop; cereals.
Macdonald's eye	<i>Galinsoga parviflora</i>	Omondeere	Most arable crops.
Couch grass	<i>Digitaria scalarum</i>	Ekenyambi	Most arable crops; <i>Brassicaceae</i> .
Nut grass/sedge	<i>Cyperus rotundus</i>	Chindwani	Most arable crops pastures
Star grass	<i>Cynodon dactylon</i>	Emuurwa	Most arable crops like legumes.
Wandering jew	<i>Commelina benghalensis</i>	Rikongiro	Most arable crops.
Sodom apple	<i>Solanum incanum</i>	Omoratora	Most arable crops like kales
Bracken fern	<i>Pteridium aquilinum</i>	Eengwe	Most arable crops; legumes
Oxalis (Sorrel)	<i>Oxalis latifolia</i>	Enyonyo	Most arable crops; <i>Solanaceae</i>
Lion's ear/tail	<i>Leonotis mollissima</i>	Risiibi rinetu	Most cultivated crops; Legumes
Black night shade	<i>Solanum nigrum</i>	Rinagu	Most cultivated crops.
Seaport goosefoot	<i>Chenopodium opulifolium</i>	Rinyabogundo	Most arable; <i>Brassicaceae</i>
Devil's Horse Whip	<i>Achyranthes aspera</i>	Esaraara	Most cultivated crops; Pyrethrum
	<i>Emilia brachycephala</i>	Omonyaboba	Most arable crops; Cereals
Thorn apple	<i>Datura stramonium</i>	Omotabararia	Most cultivated crops; Bananas

**DISCUSSIONS****Weed Species Duration of Germination to Flowering**

Most of the weeds were annuals which propagate by seeds only. Similar studies conducted by Qureshi and Arian (2003) reported that weeds like *G. parviflora*, *E. brachycephala*, *A. hybridus* and *B. pilosa* have a short life span and thus grow and mature within one season. Due to smaller seed size, most of these seeds get easily dispersed within farms, *B. pilosa* seeds are able to attach to animal fur and human clothes aiding dispersal. On the basis of their growth cycle/lifespan, the annual weeds whether broadleaved or narrow leaved are able to germinate, grow and mature in the field within a period of one season/year or less and most of them are easily controlled especially if it is done before flowering. The perennial weeds also narrow leaved or broad-leaved take more than one year/season to complete their lifecycles and are most difficult to control.

**Weed Species Traits**

Weed species portray variations in potentiality to compete with arable crops at analogous density magnitudes and this is attributed to their differences in growth habits and

allelopathic effect they may pose on sprouting and development of adjacent crops. This study found that weeds have a variety of attributes that aid them to survive and compete favourably with desired crops (Table 2). Such competitive characteristics enable them to consume large amount of habitat resources and deprive the crops. Broad-leaved weeds are not as detrimental as the grasses and sedge in crop production. However, they cause some damage and should not be over looked. Some produce many seeds making them difficult to control such as the Pig weed (*A. hybridus*) though adequate weed management practises such as through repeated shallow cultivation can check on the annual weed species.

Notably, the annual species were higher in abundance than perennial species and annual broadleaved species were dominant than perennial broadleaved species and grasses. In this study, most of the abundant weed species were annual and broadleaved in nature. In related studies done by Kimemia and Nyabundi (1998) on different weed control methods in coffee in Kenya, it was also noted that the broadleaved weeds were more in number of species as compared to the rest of the weed species. They also indicated that *C. dactylon* was the most common grass species while *B. pilosa* and *G. parviflora* were the most abundant broad leaved weed species where *T. minuta* recorded zero dominance since they relatively grew faster with highly competitive abilities. Since weeds compete with arable crops for resources such as water, nutrients besides light, it has been a matter of great concern for farmers (Rajput et al., 2008; Sultan and Nasir, 2007).

The losses caused to agricultural crops by weeds such as *C. rotundus* are quite significant (Marwat and Khan, 2006). Weeds have specific characteristics that help their survival like having elaborate root systems which is useful in anchorage, nutrient absorption and also water uptake from the soil (*A. hybridus*, *G. parviflora*), different modes of propagation like suckers, bulbs, stolons, rhizomes and corms (*P. clandestinum*, *C. dactylon* and *C. rotundus*) and succulent stems to withstand desiccation (*C. benghalensis*). Such competitive characteristics aid these weeds to deprive and consume large amount of habitat resources meant for the desired crops.

### **Crops Affected on the Farms**

Most weed species are found in cultivated crops and have been discovered to exert a significant effect on the potential yield of major crops such as the cereals, legumes and pastures (Tanveer et al., 2015). Weed species such as *Pennisetum clandestinum*, *Oxalis latifolia*, *Cyperus rotundus*, *Amaranthus hybridus* and *Datura stramonium* prevail uniquely in particular crop like maize, tea or bean fields where they cause significant crop damage (Bajwa, 2014). Related studies carried out by Gesimba and Langat (2005) in Kisii highlands noted that perennial grasses and sedges are the most common and problematic weeds of arable crops. They cause significant damages and are also difficult to control. Such grasses weeds include Couch grass (*Cynodon dactylon*). According to Shah and Khan (2006), it has been established that *Cyperus rotundus* is one of the most invasive weed species, having successively dispersed out to a global distribution in both tropics and temperate regions. Thus, it has been referred to as "the world's worst weed" as it is known as a weed in over 90 countries, and infesting over 50 crops worldwide.

## **CONCLUSION**

Most weed species exhibited a relatively short life span and this enabled them to germinate, grow and reach maturity before harsh environmental conditions set in. Weeds have traits

that enhance successful weed species survival on farms regardless of management practises which include having a short growth cycle and effective mode of dispersion.

## RECOMMENDATIONS

Farmers to be encouraged to continue studying weeds, their damage, control and have weed cultural knowledge which should be passed to the subsequent lineages.

### Conflict of interest

“The author(s) declare(s) that there is no conflict of interest.”

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