

Some Aspects of the Biology of *Vernonia cinerea* (Linn.) Less. in Awka Town, Anambra State, Nigeria.

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Abstract- Studies were carried out in a screen house, in a compound off Arthur Eze Avenue, Awka, Anambra State, using germinated seeds in five polythene bags to determine the life cycle characteristics, and the seeding potential of *Vernonia cinerea* (Linn.) Less. Results of the vegetative growth studies showed that *V. cinerea* had a mean height of 103.8 ± 34.4 cm, the mean number of leaves per plant was 301 ± 133 , the mean number of branches of stem was 19 ± 3 and the mean life cycle duration was 28 ± 2 weeks. Results of the studies on the reproductive potential of *V. cinerea* showed that the mean number of buds per plant was $1,050 \pm 883$, the mean number of seeds per capitulum was approximately 21 ± 0.6 , and the mean number of seeds per plant was $21,774 \pm 18,740$. The phenological observations of *V. cinerea* showed that the vegetative phase lasted for 8 weeks before the appearance of the flower buds which marked the beginning of the reproductive phase, while the reproductive phase of *V. cinerea* lasted for 20 weeks, from the appearance of flower buds to the time the plant withered. It is concluded from the result that *V. cinerea* has the ability to flower and fruit within a period of 5 months, with life cycle duration of approximately 7 months. And that the high seed production potential of *V. cinerea* will help it survive competition in areas where it occurs.

Index Terms- Life cycle, phenology, seeding potential, *Vernonia cinerea*.

I. INTRODUCTION

Vernonia cinerea (Linn.) Less. is a member of the Asteraceae family, belonging to the class: Dicotyledonae; order: Asterales and tribe: Vernonieae. It is an erect, slender, rarely branching annual herb that grows up to 1.3 m tall. The stems are finely pilose and glandular. The leaves are alternate, lower ones being petiolated while the upper ones are reduced and sessile. They measure between 2-6 cm long; more or less, densely and finely hairy (Harborne and Williams, 1977). The heads are small, about 7 mm long and 2.5 mm in diameter. The flowers are all tubular, rather bright purple, pink, or white about 20 in each head, twice as long as the involucre bracts. The pappus bristles, measure 3-5 mm long. The achenes are rounded, nearly ribless and measure about 1.5 mm long (Harborne and Williams, 1977). *Vernonia cinerea* is an annual plant widely distributed in Africa, India, Bangladesh and Srilanka. It is commonly known as little iron weed. Its other names include; blue fleabane, inflammation bush, strongman bush, tropical fleabane, goat weed and ash-coloured fleabane (Herrera *et al.*, 1980). *V. cinerea* is native to Africa (e.g Benin, Cameroon, Nigeria, Gabon, Ghana, Kenya,

Liberia, Madagascar etc.), tropical and temperate Asia (e.g China, Fujian, Bangladesh, Jiangxi, India, Japan, Indonesia, Malaysia etc.) and Australia (Harborne and Williams, 1977). *V. cinerea* occurs mostly in sunny or slightly shaded habitats, in general corresponding with young secondary vegetation, wasteland, roadsides, disturbed areas, cultivated land and other anthropogenic habitats (Harborne and Williams, 1977). *V. cinerea* reproduces and spreads by seeds which are adapted to wind dispersal. In addition, seeds may be secondarily dispersed as a contaminant in crop seeds, pasture seeds, and in agricultural machinery (Holm *et al.*, 1997). *V. cinerea* is a herbaceous plant of high medicinal value. Ground leaves or a poultice of leaves of *V. cinerea* are a remedy for headache and when mixed with a little lime they are also applied to dress wounds (Herrera *et al.*, 1980). The leaves either ground or as a decoction, are also used against skin diseases (Oliver, 1986).

Phenology is the study of periodic plant life cycle events and how these are influenced by seasonal and inter-annual variations in weather (George and Bell, 2001). Zhang *et al.* (2006) stated that the study of plant phenology provides knowledge about the pattern of plant growth and development as well as the effects of environment and selective pressures on flowering and fruiting behavior. In the study of plant phenology, Wittwer and Robb (1964) stated that a green screen house is a building or complex in which plants are grown. With emergence of the radicle during germination, seedling establishment begins and may not be considered successful until an adequate root system and leaf area have developed to sustain a high rate of growth (McKell, 1972). Fenner (1987) stated that in a strict physiological sense, a plant developed from a seed is a seedling as long as it depends on seed reserves. Roberts (1939) stated that vegetative growth is triggered by photoperiod and temperature and reproductive initiation is triggered primarily by photoperiod. Dahl (1995) stated that the reproductive phase of a plant is triggered primarily by photoperiod but can be slightly modified by temperature and precipitation. Akobundu and Agyakwa (1998) stated that *Vernonia cinerea* is propagated by seeds, flowering and fruiting throughout the year.

The objectives of this study are to establish the life cycle characteristics as well as the seeding potential of *Vernonia cinerea*, so as to acquire some knowledge on the plant's growth cycle.

II. MATERIALS AND METHODS

This study was carried out in a screen house, off Arthur Eze Avenue, Awka, using the germinated seeds in polythene bags. Awka town lies between latitudes $7^{\circ}00'$ and $7^{\circ}10'$ N and

longitudes $6^{\circ}05'$ and $6^{\circ}15'$ E (Richards, 2005). A total of five perforated polythene bags were filled with top soil (loam) and five seeds were sown in each perforated polythene bag. They were moistened adequately and observed daily for germination.

As soon as the seedlings emerged from the soil, growth and phenological observations followed immediately on a weekly basis, and at the end of the first week after germination, the seedlings were reduced to one seedling per bag.

At each sampling date (once every seven days), the shoot systems were observed. The branching system of the shoot was followed up to determine the plant's habit of growth. When the reproductive phase started, that is from the appearance of flower buds, observation was no longer on a weekly basis, but on a daily basis.

The time taken for the different reproductive phases, including flowering period (onset & end of flowering dates), fruit set and fruit maturity, was recorded.

In addition, the following attributes were recorded on a weekly basis:

1. plant height (cm);
2. number of leaves per plant and
3. number of primary branches developed on the main stem.

Reproductive characters that were quantified included:

1. mean number of buds per plant;
2. mean number of seeds per capitulum and
3. mean number of seeds per plant.

These investigations were complemented with observations of the plant in the field.

Computation and Statistical Analysis of Data

Data obtained were analysed statistically using mean and confidence limit at 95 % level of probability.

III. RESULTS

Vegetative and Reproductive Growth of *V. cinerea*

The seeds planted on the 3rd of July, 2013, in a screen house, germinated after four days of sowing. All the seeds that were sown in the five polythene bags germinated. The emergence of the plumule (seedling establishment) marked the beginning of the vegetative phase. On week 3, the mean plant height was 6.4 ± 1.4 cm and, the mean number of leaves was approximately 8 ± 1.4 (Figure 1). The plant started producing primary branches on

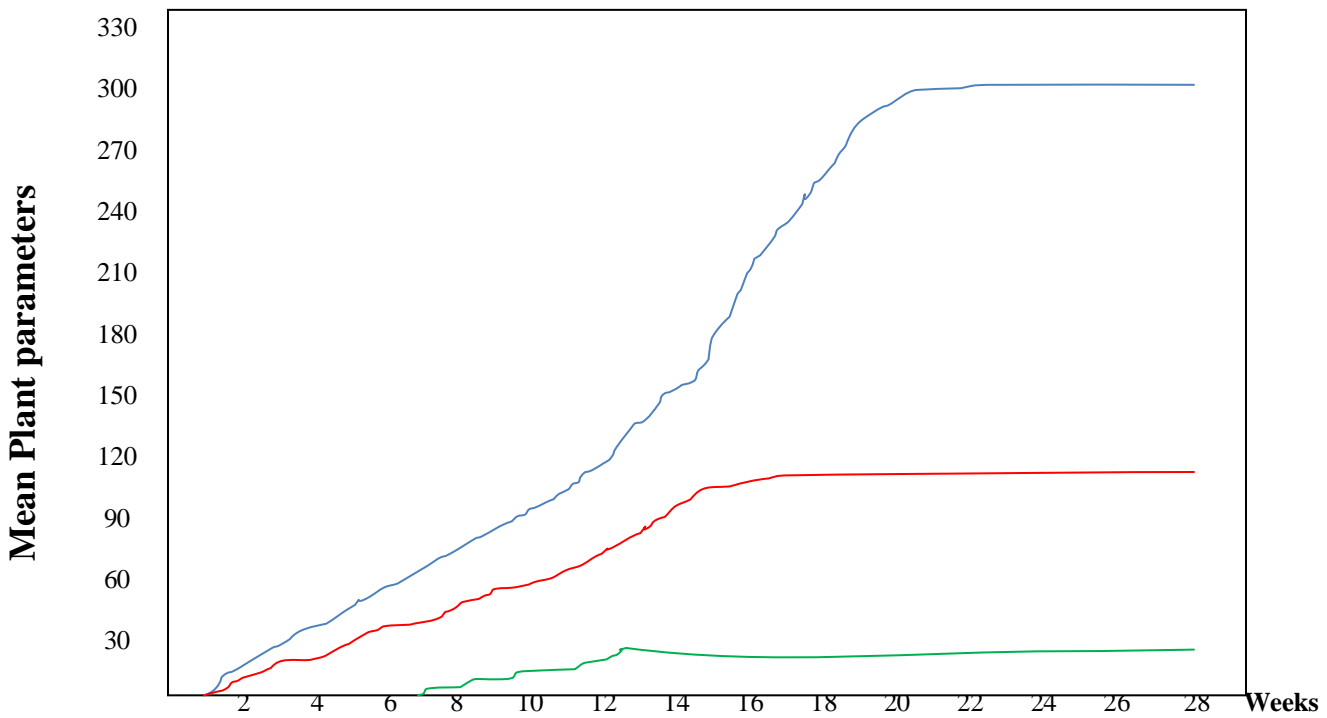
week 7 and it stopped on week 13 (Figure 1). The vegetative phase lasted for 8 weeks (Table 3) before the appearance of flower buds (week 8), which marked the beginning of the reproductive phase. The mean height of the plant at this date was 31 ± 10.5 cm, while the mean number of leaves of the plant was approximately 41 ± 17.8 (Figure 1). The appearance of flower buds lasted for a mean of 20.2 ± 1.1 days (Table 3) before the opening of the flower buds on week 11. The mean height of the plant at this date was 78.2 ± 10.7 cm, the mean number of leaves was approximately 95 ± 32.7 and the mean number of branches of stem was 17 ± 3.6 (Figure 1). The opening of the flower buds lasted for a mean of 13.2 ± 0.6 days (Table 3), before the appearance of parachute of hairs containing seeds on week 13. The mean height of the plant at this date was 92.8 ± 20.7 cm, the mean number of leaves was approximately 113 ± 27 and the mean number of branches of stem was 19 ± 3 (Figure 1). The production of new branches of stem stopped at the start of the fruiting stage (week 13). The appearance of parachute of hairs lasted for a mean of 7.2 ± 0.6 days (Table 3), before the plant shed its fruit (fruit maturity). The minimum number of seeds per plant (a mean of 477 ± 162 seeds) was produced on week 15, while the maximum number of seeds per plant (a mean of 2519 ± 2216 seeds) was produced on week 19. Flowering and fruiting period (reproductive phase) lasted for a mean of 139 ± 14 days before the plant withered (Table 3). Observations showed that *V. cinerea* flowers and fruits at any given time of the year. Observations of the vegetative growth characteristics of *V. cinerea* (Table 1) showed that the plant attained a mean height of 103.8 ± 34.4 cm, a mean number of leaves of 301 ± 130 , a mean number of branches of stem of 19 ± 3 and a mean life cycle duration of 28 ± 2 weeks.

Reproductive Potential of *V. cinerea*

The mean number of buds produced per plant was $1,050 \pm 883$, the mean number of seeds produced per capitulum was 21 ± 1 and the mean number of seeds produced per plant was $21,774 \pm 18,740$ (Table 2).

Vegetative growth Parameters

- Plant Height (cm)
- No. of leaves per plant
- No. of primary branches



Error Bars: 95 % CI

Figure 1: Graph illustrating the weekly vegetative growth parameters of *V. cinerea*

The graph (Fig 1) above showed that the plant height increased gradually from week 1 to week 22, where it attained a mean height of 103.4 ± 34.0 cm, and the plant height stopped to increase on week 23, at a mean height of 103.8 ± 34.3 cm. The number of leaves per plant increased exponentially from week 3 to week 25, where it produced a mean number of leaves of $298 \pm$

130, and the plant stopped producing leaves on week 26, at a mean number of leaves of 301 ± 130 . It also showed that the primary branching started on week 7 and stopped on week 13 when the plant attained a mean of 19.0 ± 3 branches on the main stem.

Table 1: Duration of the vegetative growth parameters of *V. cinerea*

Plants	Height (cm)	No. of Leaves	No. of Branches of Stem	Life Cycle Duration (in weeks)
1	148	479	20	30
2	90	300	20	28
3	92	214	21	28
4	112	275	19	29
5	77	238	15	26
Mean±CL	103.8 ± 34.4	301 ± 130	19 ± 3	28 ± 2 weeks

Data were statistically analysed using mean and confidence limit at 95 % level of probability.

Table 2: Reproductive growth of *V. cinerea*

Plants	No. of Buds Per Plant	No. of Seeds Per Capitulum	No. of Seeds Per Plant
1	2,275	21	47,775
2	834	21	17,514
3	518	20	10,360
4	902	20	18,040
5	723	21	15,183
Mean ± CL	$1,050 \pm 883$	20.6 ± 0.6	$21,774 \pm 18,740$

Data were statistically analysed using mean and confidence limit at 95 % level of probability.

Table 3: Durations of the vegetative and reproductive phases of *V. cinerea*

Plants	Vegetative phase (in days)	Appearance, to opening of flower buds (in days)	Opening of flower buds to appearance of parachute of hairs (in days)	Appearance of parachute of hairs to start of wilting of flowers (in days)	Reproductive phase (in days)
1	61	19	13	7	149
2	53	21	14	7	143
3	62	20	12	7	134
4	55	21	14	8	148
5	50	20	13	7	120
Mean±CL	56 ± 5.6	20.2 ± 1.1	13.2 ± 0.6	7.2 ± 0.6	139 ± 14

Data were statistically analysed using mean and confidence limit at 95 % level of probability.

IV. DISCUSSION

Observation from the growth studies of *V. cinerea* showed that the seed of the plant germinated in 4 days, and this is in line with that of Akinola and Jennifer (1993) who reported that the emergence of the radicle of *V. cinerea* from the soil surface took 3 days after imbibitions and the establishment of its seedlings in a natural environment took 5-6 days. The observed difference may be as a result of difference in soil and environmental conditions (though not investigated). Observation from the growth studies which also showed that the vegetative phase of the plant lasted for 8 weeks before the appearance of the flower buds (mature plant), is not in line with that of Akinola and Jennifer (1993) who reported that the seedlings of *V. cinerea* grew into mature plants within four weeks after germination. This observed difference could be as a result of difference in the climatic and edaphic factors of the two areas of study (though not investigated). Observation from phenological studies which showed that the plant could flower and fruit at any given time of the year, and that, this flowering and fruiting period (reproductive phase) lasted for a period of a mean of between 4 months and 3 days and 5 months and 1 days, is in agreement with that of Jordano (1992) who noted that in the tropical community, there are usually some species that are in fruit at any given time of the year, and individual species tend to have longer fruiting periods, with a mean of more than 4 months. In addition, Murali and Sukumar (1994) noted that the timing of flowering is one of the most widely investigated aspects of the phenology of plant life-cycles. Observation from the growth characteristics of *V. cinerea* showed that the plant attained a mean height of between 69.4 cm (0.694 m) and 138.2 cm (1.382 m), and this can be related to that of Dogra *et al.* (2009) who noted in his study that *Ageratum conyzoides* (like *V. cinerea*, which belongs to the family: Asteraceae) can gain height of up to 2 m in the Shivalik hills. The difference in these observations may be due to differences in plants and study areas. In addition, Akinola and Jennifer (1993) stated that the size of a mature plant depends on the environment in which the plant is growing. Observations from the growth parameters also showed that the mean number of leaves of *V. cinerea* was between 171 and 431, the mean number of branches of stem was between 16 and 22 and the

mean life cycle duration was between 26 weeks and 1 day and 30 weeks and 1 day. These phenological observations provided information about the pattern of growth and development of *V. cinerea*. This is in agreement with what Zhang *et al.* (2006) stated that the study of plant phenology provides knowledge about the pattern of plant growth and development as well as the effects of environment and selective pressures on flowering and fruiting behaviour.

Observation from the records of the reproductive potential of *V. cinerea* which showed that the mean number of buds per plant was between 167 and 1,933, the mean number of seeds per capitulum was between 20 and 21.2 and the mean number of seeds per plant was between 3,034 and 40,514 contradicts that of Akinola and Jennifer (1993) who reported that *V. cinerea* produces 100-800 capitula per plant which bear 2,500-20,000 seeds (achene). The difference in these observations could be as a result of difference in the environmental conditions, even though these were not investigated.

V. CONCLUSION

The ability of *Vernonia cinerea* to flower and fruit at any given time of the year and within a period of 5 months, and its high seeding potential will help it survive competition in places where it occurs.

REFERENCES

- [1] Akinola, M. O. and Jennifer, A. O. (1993). Some aspects of the autecology of *V. cinerea* (Linn.) Less. *Nigerian Journal of Botany* 6:211-216.
- [2] Akobundu, L. O. and Agyakwa, C. W. (1998). *A Handbook of West African Weeds*. 2nd edition, International Institute of Tropical Agriculture, Ibadan, Nigeria. 564pp.
- [3] Dahl, B. E. (1995). Development morphology of plants. In: D.J. Bedunah and R.E. Sosebee (eds.), *Wildland plants: physiological ecology and developmental morphology*. Denver, CO: Society for Range Management. pp. 22-58.
- [4] Dogra, K. S., Kohli, R. K. and Sood, S. K. (2009). An assessment and impact of three invasive species in the shivalik hills of Himachal Pradesh, India. *International Journal of Biodiversity and Conservation* 1(1):004-0010.
- [5] Fenner, M. (1987). Seedling. In: *Frontiers of comparative plant ecology*, London: Academic Press. pp. 35-47.

- [6] George, M. and Bell, M. (2001). *Using Stage of Maturity to Predict the Quality of Annual Range Forage*. Oakland, CA: University of California Division of Agriculture and Natural Resources Publication 8019. pp. 7.
- [7] Harborne, J. B. and Williams, C. A. (1977). Vernonia – Chemical Review. In: *The Biology and Chemistry of Compositae* (Volume 1). Academic Press, London. pp. 523-537.
- [8] Herrera, C. L., Chanco, G. L. and Sison, F. M. (1980). Chemical and Pharmacological Studies on Vernonia patula and Vernonia cinerea. In: *4th Asian Symposium on Medicinal Plants and Spices: Abstracts*. Department of Chemistry, Faculty of Science, Mahidol University, Bangkok. 249pp.
- [9] Holm, L., Doll, J., Holm, E., Pancho, J. and Heiberger, J. (1997). *World Weeds: Natural Histories and Distribution*. John Wiley and Sons, New York, United States. 1129pp.
- [10] Jordano, P. (1992). Fruit and Frugivory. Seeds: *The Ecology of Regeneration in Plant Communities* (ed. M. Fenner), CAB International, Oxford. pp. 105-156.
- [11] McKell, C. M. (1972). Seedling vigor and seedling establishment. In: Younger, V. (ed.). *The Biology and Utilization of grasses*. New York, NY: Academic Press, Inc. pp. 74-89.
- [12] Murali, K. S. and Sukumar, R. (1994). Reproductive phenology of a dry forest in Mudumalia, Southern India. *Journal of Ecology* 82:759-767.
- [13] Oliver, B. B. (1986). *Medicinal Plants in Tropical West Africa*. Cambridge University Press, Cambridge. 125pp.
- [14] Roberts, R. M. (1939). Further Studies of the Effects of Temperature and other Environmental Factors upon the Photoperiodic response of Plants. *Journal of Agricultural Research* 59 (9):699-709.
- [15] Wittwer, S. H. and Robb, W. M. (1964). Carbon-dioxide Enrichment of Green-House Atmospheres for Food Crop Production. *Economic Botany* 18:34-56.
- [16] Zhang, G., Song, Q. and Yang, D. (2006). Phenology of Ficus racemosa in Xishuanghanna southwest China. *Biotropica* 38:334-341.

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