Published November, 1981

Description of Sunflower Growth Stages[1]

A.A. Schneiter and J.F. Miller[2]

ABSTRACT

A standardized, accurate, and easy system is needed to describe sunflower (*Helianthus annuus* L.) plant development. The objective of this study was to develop and describe stages of sunflower plant development in a manner which is simple but accurate.

Plants were divided into either Vegetative (V) or Reproductive (R) stages of plant development. Vegetative development is divided into two phases, emergence and true leaf development. The latter stages are determined by the number of true leaves in excess of 4 cm in length. The number of vegetative stages is dependent upon the number of true leaves formed by the plant, making the method flexible but accurate. The reproductive development was divided into nine stages based on the development of the inflorescence from its initial appearance through anthesis to physiological maturity of the seed. This method of describing the stages of development in sunflower is rapid, accurate, greatly simplifies current methods, and can be used to determine plant development for either single or branched inflorescence sunflower.

Additional index words: Morphology, Anthesis, Physiological maturity, Vegetative development, Reproductive development.

THE description of specific stages of plant development is not a new concept and many excellent methods have been developed including those for dry edible beans (*Phaseolus vulgaris* L.) (5.), soybeans (*Glycine max* L.) (3), cotton (*Gossypium hirsutum* L.) (2), and corn (*Zea mays* L.) (1, 4). Criteria used for the description of growth stages vary among crops and are dependent upon the growth characteristics of plant species.

Staging of sunflower (*Helianthus annuus* L.) plant development has been proposed by at least two workers (6, 7). Robinson (6) described five stages of growth between emergence and maturity. These stages were (1) planting to emergence, (2) emergence to head visible, (3) head visible to first anther, (4) first anther to last anther and (5) last anther to maturity. Siddiqui et al. (7) expanded upon these general classifications by dividing them into subclasses. Some of the criteria used in the resultant classification system (7) are not reliable indicators, especially those involving leaf senescence. A simplified classification system should involve describing a specific stage of plant growth as being either in the vegetative (V) or reproductive stage (R). The V and R stages are subdivided into easily identifiable subgroups which are independent of environmental influence or genotype. This same system can be used for classifying both single head or branched sunflower. In the latter type the determinations are made by using only the main branch or head.

[1]Joint contribution from the Agric. Exp. Stn., North Dakota State Univ., Fargo, ND, and the USDA-SEA-AR. Contribution No. 1124. Received 9 Jan. 1981. This research was supported in part by a grant from the National Crop Insurance Association and the Crop Insurance Research Bureau.

[2]Associate professor of agronomy and research geneticist, USDA-SEA/AR, respectively, Dep. of Agronomy, North Dakota State Univ., Fargo, ND 58105.

Fig. 1. Representative Vegetative (V) and Reproductive (R) growth stages in sunflower.

GROWTH STAGES

Vegetative

The vegetative (V) stage of plant development as described in this method of staging, begins with emergence of the seedling and ends with the initial visual appearance of the inflorescence. The individual stages after emergence are determined by leaf number. The number of days between vegetative stages is variable and is dependent upon genotypic and environmental factors.

Stage *Description*

VE The hypocotyl arch and cotyledons have emerged through the soil surface and the first true leaf blade is less than 4 cm in length (Fig. 1, VE). The criterion of not counting a leaf blade until it has attained a length of 4 cm does not represent a distinct physiological stage of leaf development. It is simply a guideline to eliminate some of the confusion which can occur as a result of the very small leaflets which surround the terminal bud.

V(N) The number of true leaves at least 4 cm in length are counted beginning as V1, V2, V3, V4, etc. (Fig. 1, V4). Leaf attachment in sunflower appears to begin in an opposite arrangement and gradually develops a spiral phyllotaxy of alternate leaves. In a system for sunflower staging previously proposed (7), the development of opposite and alternate leaves is considered as two distinct stages of plant development. The change in leaf phyllotaxy is gradual, and the point at which the distinction occurs is not always clear, resulting in margin for error. In addition, the point at which the change occurs may vary from plant to plant within a given hybrid grown under similar environmental conditions.

As the plant develops, bottom leaves may begin to senesce, due to drought, disease, or other factors. When leaves are lost, leaf scars (excluding those at the cotyledonary node) plus leaves must be counted to determine the proper stage of plant development. In the system proposed by Siddiqui et al. (7) senescence of lower leaves was used as a stage for plant maturity. Varying degrees of lower leaf senescence prior to and during anthesis have been observed, thus decreasing the reliability of leaf senescence as a stage indicator.

Reproductive

Reproductive (R) stages of plant development begin with the first appearance of the inflorescence and end with plant maturity. Unlike the vegetative stages, the reproductive stages are dissimilar in appearance and a description of each is given.

Stage *Description*

R1 The inflorescence surrounded by immature bracts becomes visible (Fig. 1, R1). When viewed from directly above, the immature bracts have a many pointed star-like appearance. The appearance of this stage relative to leaf number may vary among genotypes.

R2 The internode directly below the base of the inflorescence elongates 0.5 to 2.0 cm above the nearest leaf attached to the stem. Some plants may have adventitious bracts at the base of the receptacle but these should be disregarded in the staging procedures (Fig. 1, R2)

R3 The internode immediately below the reproductive bud continues to lengthen, lifting the inflorescence head above the surrounding leaves in excess of 2 cm.

R4 The inflorescence begins to open. When viewed from directly above, small ray flowers are visible.

R5 This stage is the beginning of anthesis. The mature ray flowers are fully extended and all disk flowers are visible. This stage can be divided into substages dependent on the percent of the head area that has completed or is in anthesis. For example, if 50% of the disk flowers have completed or are in anthesis, the stage would be R5.5. If 80% of the disk flowers have completed or are in anthesis, the stage would be R5.8 (Fig. 1, R5.8). This determination should be estimated or calculated on a total head area basis and not on head diameter or radius.

R6 Anthesis is complete and the ray flowers have lost their turgidity and are wilting. The ray flowers may or may not wilt and abscise immediately (Fig. 1, R6).

R7 Back of the inflorescence has started to turn a light yellow color. The yellowing may begin either at the center of the head near the base of the receptacle or at the periphery adjacent to the bracts.

R8 Back of head is yellow but the bracts remain green. Some brown spotting may or may not be present on the back of the head (Fig. 1, R8).

R9 The bracts become yellow and brown. At this point a large proportion of the back of the sunflower head may begin to turn brown. This stage is generally regarded as physiological maturity (Fig. 1, R9). In stages R7 through R9 healthy disease-free heads should be used to determine plant development since some diseases can cause head discoloration. The total time required for development of the sunflower plant and the time between the various stages is dependent upon genotype and environment. The average development of a community of plants should be considered, but these stage descriptions apply to single plants.

REFERENCES

1. Burmood, D.T. 1968. Lower internode elongation, a method of stage growth identification for *Zea mays* L. M.S. Thesis Univ. of Nebraska, Lincoln, NE.
2. Elsner, J.E., C. Wayne Smith, and D.F. Owen. 1979. Uniform stage descriptions in Upland Cotton. Crop Sci. 19:361-363.
3. Fehr, W.R., C.E. Caveness, D.T. Burmood, and J.S. Pennington. 1971. Stage of development description for soybeans, *Glycine max*. (L.) Merrill. Crop Sci. 11:929-931.
4. Hicks, D.R. 1979. Standardizing developing stages for corn and soybeans. Am. Soc. Agron. Abstr. p 10.
5. Lebaron, M.J. 1974. Developmental stages of the Common Bean Plant. Current Inf. Series No. 228. College of Agric., Univ. of Idaho, Moscow, ID.
6. Robinson, R.G. 1971. Sunflower phenology—year, variety, and date of planting effect on day and growing degree—day summation. Crop Sci. 11:635-638.
7. Siddiqui, M.Q., J.F. Brown, and S.J. Allen. 1975. Growth stages of sunflower and intensity indices for white blister and rust. Plant. Dis. Rep. 59(1):7-11.