AN OBJECTIVE DESCRIPTION OF SUNFLOWER FOR VARIETAL REGISTRATION, PLANT VARIETY PROTECTION AND OTHER PURPOSES.

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ABSTRACT

Various formats are in current use in several countries for the purpose of giving an objective identifying description of sunflower varieties, lines and/or hybrids. After considerable study trying to meet the various requirements, we have developed a form which inventories approximately 100 characteristics in a sequential standard format. This form is being used in consideration for revision of the USDA Plant Variety Protection form for sunflowers (*Helianthus annuus*). The proposed format is by no means an exhaustive list, but might serve several useful purposes.

1. Provide a morphological profile for use by breeders and seed producers to more completely describe advanced materials and those items in production.

2. Supply the needed information in applying for varietal registration or protection in several countries.

3. Serve as a basis for developing new forms, or standardization of existing forms in all countries concerned with precise sunflower descriptions.

An attempt is made to clarify descriptive traits, standardize measurements and to utilize standard varieties, lines or hybrids in classifying characteristics modified by climatic conditions.

INTRODUCTION

In 1957 an international conference on plant variety protection was convened in Paris. Delegates from eight countries of Western Europe met to discuss the issue of breeders' rights and the need for variety protection. The delegates met again in 1961, and the outcome was a set of guidelines under which member states could develop a uniform system for variety protection which would be open equally to all citizens of members states. What began as a convention in Paris is now known as UPOV, or International Union for the Protection of New Varieties of Plants, with headquarters in Geneva Switzerland (Poehlman, 1969).

In subsequent years most countries of Western Europe have created special breeders' rights through a registration process which requires several years of field testing. This is sometimes referred to as the "grow-out" system. The United States' system for varietal protection utilizes a massive comparison of characteristics by computer with no field testing. To my knowledge, both systems have at least one item in common, they require proof of newness or novelty. The burden of proof rests with the applicant and usually takes the form of a detailed description including a comparison to standard cultivars. We call this description a morphological profile. It is this morphological profile of the genotype that I would like to discuss.

It would be convenient if sunflower had "fingerprints" or some unique characteristic for each genotype. A method of "fingerprinting" using gel electrophoresis of isozymes shows promise as a means of identifying specific genotypes rather than phenotypes. This system might reduce the impact of environmental factors (Abernethy and Evans, 1981; Stuber and Goodman, 1981). So far government agencies have been reluctant to accept this type of evidence. So in the absence of such a characteristic, we are forced to describe each genotype as completely and accurately as possible.

My intention is to stimulate an awareness of and an interest in this problem. Perhaps we can also serve as a catalyst for further action.

MATERIALS AND METHODS

My breeding program has now advanced to the point where we have proprietary hybrids to market. We found that each country has its own requirements for registration as well as its own morphological description. While some items on the forms are the same, many are different. In order to collect the information needed to complete forms for three different countries, we developed a composite four-page form which inventories approximately 100 different characteristics. The three countries of interest to us had only 15 specific characteristics in common. A copy of our form, along with the forms used by France, Spain and the United States are displayed in the poster section. This form is a preliminary attempt to consolidate the information necessary to adequately describe specific cultivars. Improvements can undoubtedly be made.

It is evident that a uniform system of description would be most helpful. The forms we compared were similar in many respects. For example, one requires the average internode length, and another requests the length of the four internode. If internode length is a valuable descriptive factor, data collection would be simplified if the countries involved could agree on which internode to measure.

We encountered a number of other problems, not the least of which is trying to interpret what data is required. For example, one form calls for the "color of the growing point." We never did find anyone who could tell us what this meant until we persued the matter to the government official who made up the form. He admitted that he had never seen a field of sunflower! This problem of terminology is further compounded by language barriers.

Another complicating factor is the degree to which the environment can influence the expression of certain genotypes. In our attempt to accurately describe the genotype, we see and measure the phenotype, which is actually the expression of the genotype modified by the environment. Because this environmental modification may vary greatly, we should separate the traits into two categories. (1) In some characteristics such as petal color, the environment has minimal effect on the genetic expression. Traits of this type may be relatively easy to describe and remain stable under a wide range of conditions. (2) Other factors such as plant height, head size and yield may not only be conditioned by a large number of genes, but may also be greatly influenced by several environmental factors. Such traits, although commercially important, are useful descriptors **only** when carefully referenced within the same environment and to known standards. Here replication is required in order to predict a reliable mean.

The selection of good standard (reference) varieties, hybrids or inbreds is very important. Criteria for their selection should include: uniformity, wide-spread distribution, availability of seed for testing, large amounts of information concerning the cultivar, and vigorous growth (to allow for ease of use). Such standards should be available for many years, deposited in gene banks and world collections, and carefully cross-indexed to previous, current and future cultivars which have or may be used as reference standards.

A number of marker genes have been identified within the *Helianthus* genus, but the cultivated genotypes are very similar because of breeding and selection. The challenge of describing uniqueness is usually limited to **visible** morphological differences plus a few measurable physiological differences.

RESULTS

I would now like to use some of the criteria from our form as a tool to further point out the need to clarify and

standardize the measurement of descriptive traits.

It seems logical and convenient to collect the required data in chronological order by stages of development. Therefore, a precise description of stages of growth is needed (Schneiter and Miller, 1981; Coultas, 1980).

Seedling stage. Hypocotyl pigmentation is easily identified, but low temperature, salt and/or drought tolerance are more difficult to measure. Reaction to several diseases can be observed during this stage.

Bud stage. Just prior to the appearance of a flower bud, the terminal cluster of leaves gives the appearance of a star. This describable stage of development is an indicator of relative maturity. As the bud forms and increases in diameter, it may be classified as "open" or "closed" by referring to whether or not the center is visible. While this is clear cut in some genotypes, there are those which are "neither" — open at one stage but closed later, or vice versa. It is not known how much this reaction is influenced by the environment.

Flowering stage. The appearance of the first ray flower is quite noticeable and easily detected, but it is probably influenced by heat, light and day-length. Some genotypes are very day-length sensitive, while others are rather stable. This important trait is not included in any of the forms.

The number of leaves per plant appears to be quite constant for a given location and is associated with days to maturity. Plants with numerous leaves are usually late maturing. Leaf size is highly influenced by the environment, especially plant spacing. Leaves on different parts of the plant also differ in size, so cultivar descriptions should specify a particular node and a specific stage of development. Shape of the leaf outline, base, tip, and margin is quite variable and stable under many environments. It is, therefore, a useful identifier. We found simple drawings of possible shapes (Knowles, 1978) to be most helpful. Leaf conformation and surface texture are also helpful. Knowles has suggested that the length of the petiole, its shape in cross section, and the angle of the petiole to the main stem may be constant enough to be used in varietal description.

We noticed that most of the genotypes we investigated had one or two leaves attached to the back of the head, while there were some with many leaves, and some with none. This may be a useful trait.

The presence or absence of ray flowers is easily detected and appears unaffected by the environment. However, the length and width of ray petals is highly variable, even within the same head. Ray and disk flower color, on the other hand, seem to be very stable and are useful descriptors as is the presence or absence of anthocyanin in the bracts, stigmas and pappi.

Physiological maturity. Days to physiological maturity, while largely environmentally influenced, would still be a distinguishing factor when used in comparison to a reference standard. Growing degree days, an accumulative measure of temperature and days, may be preferred to days alone as a measuring unit.

Branching pattern. Sunflowers range from the single-flowered type to many variations of branched types. The branching pattern may be a useful descriptive trait in multi-flowered lines. Branches vary in length from a few centimeters in length to longer than the main stem. Branches may be concentrated at the top of the plant, at the base of the plant, or may be fully branched with no central head (Knowles, 1978).

Harvest maturity. This is a more difficult point to define than is physiological maturity. Both are very judgmental compared to the black layer indicator found in corn and sorghum. If days to harvest maturity are to be used for identification, close comparisons within the same planting date and environment will be necessary.

Plant size. Plant height, stem diameter and head diameter are all greatly influenced by the environment. These traits are useful for description if measurements are replicated and include comparisons to reference standards.

Stalk strength. We are interested in percent root lodging and stalk breakage as selection criteria but question their usefulness for descriptive purposes. Contributing factors such as insects and disease can be so localized that it makes it difficult to separate out differences in lodging alone.

Seed descriptions. Seeds can be just as variable and distinctive as plant types. Some seed characteristics such as color are influenced little by environment and are, therefore, useful in cultivar description. Achene color varies from white through different shades of brown and gray to black. Color of the outer, middle, and inner pericarp, color and position of stripes, and mottling are good descriptors.

We recommend that seed set under bag be taken in two categories: (1) percent seed set excluding center and (2) unfilled center as a percent of the head diameter. The percent kernel, or ratio of kernel to hull is a trait useful for selection as well as descriptive purposes. Grams per 100 seeds, yield per head, percent seed on top of a 20/64 screen, as well as seed length, width and thickness, even though highly influenced by environmental factors, have all been used to describe differences.

Seed comparisons can also be made between a number of physiological factors such as percent oil, percent protein, iodine number, oil quality (fatty acid composition), and other chemical compounds. Since most of these traits may be highly influenced by the environment, they should be qualified and compared within environments and to known reference standards.

Pest-plant and chemical-plant interactions. A number of other physiological characteristics involving interactions with biological and/or stress adaptation factors may be useful descriptors. These include resistance, tolerance or susceptibility to diseases, insects, birds, plant parasites and herbicides. Also included are tolerance to unfavorable soil conditions such as excess or shortage of soil salts, acidity/alkalinity, major and minor nutrients, metals, and moisture. Attractiveness to insect pollinators, including nectar quantity and quality may be described and measured.

Traits dependent upon other biological systems must be carefully measured against reactions of known reference standards. Identification of disease races such as rust and downy mildew can be most useful. If diseases are not adequately described, the information can be very misleading and incorrectly interpreted. Changes in race patterns of the pathogen complicate the information. Insects, birds, plant parasites, etc. also have similar variations.

I have not presented a complete list of descriptive traits for sunflowers. There are many other characteristics (some are simply inherited) which would make excellent identifying or descriptive criteria (Leclercq, 1968; Luczkiewiez, 1975; Skaloud, 1980).

SUMMARY

Again, my intention has not been so much to enlighten and inform as to stimulate discussion and unify efforts. I am certain there are those of you present who have served on international committees which have dealt with the dilemma of cultivar description and identification. International and regional gene banks are faced with this problem. Some have developed computer systems to store and retrieve descriptive information (Hawkes and Lang, 1973). A thesaurus of terms has been printed to help avoid confusing terminology. An international code of nomenclature has been prepared for cultivated plants by the Committee for the International Commission for the Nomenclature of Cultivated Plants (Brickell, Kelly, Schneider, Voss and Richens). Both the thesaurus and code of nomenclature should serve as a guide for developing terminology specific to sunflower.

UPOV is in the process of preparing "Test Guidelines for Sunflower" (Thiele-Wittig, 1981). A draft is being circulated to professional organizations. I further understand that Canada and a number of European and Latin American countries are working on variety protection systems (Leese, 1981). It appears to me that if standardized method of description for sunflowers could be developed, the sunflower crop would benefit through greater international exchange and marketing of new and superior sunflower cultivars. We scientists who should be the most capable of describing a sunflower ought to work together toward this common goal. A good standardized form for morphological profiles would serve us all.

RECOMMENDATIONS

It is my recommendation that (1) the Secretary of The International Sunflower Association appoint, or direct the Scientific Committee to appoint, a working committee for the development of a standardized format for the description of

sunflower cultivars; and (2) that the Secretary, or by appointment the working committee suggested, contact UPOV and offer to review their proposed draft, and (3) that the Secretary, or by appointment the working committee, serve as a clearing house for those countries or organizations wanting assistance in development of morphological profile forms for use in variety protection programs or other applications where precise detailed descriptions of sunflower cultivars is needed.

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