Instructional aids produced from these transparency masters and the accompanying narrative may be used by vocational agriculture teachers in presenting courses in plant science. They were developed by subject matter specialists and teacher educators as part of a project designed to test effects of involving vocational agriculture teachers in development and experimental use of instructional materials. Included with the transparencies are introductory material on the project, the method of research, and the results, as well as recommended uses of the masters and teaching suggestions. The transparencies are grouped under five subject areas: (1) General Plant Morphology and Structure, (2) Cereal Crops, (3) Legumes, (4) Grasses, and (5) Weed Identification. Samples of letters and questionnaires used in the research are appended. (AW)
TRANSPARENCY MASTERS
FOR
CROP AND WEED IDENTIFICATION

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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TRANSPARENCY MASTERS FOR CROP
AND WEED IDENTIFICATION.

Transparency masters for teaching plant science.

Final Report
Project No. OE7-0031
Contract No. OEG-4-7-070031-1626

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June 1968

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Special appreciation is due Ernest G. Kramer, Assistant State Superintendent of Vocational Education, and Bert Brown, State Director of Agricultural Education.

We thank Stanford Sleeth for his suggestions regarding the technical layout of the transparencies.

Appreciation is also due Al Law, Professor of Agronomy, for review of the materials presented.

Our thanks to Sharon Day for careful copy editing and preparation of this manuscript.
SUMMARY

The purpose of this project was to test effects of involving vocational agriculture teachers in development and experimental use of instructional materials.

Teachers in the field identified their agronomy curriculum needs. Subject matter specialists cooperated with teacher educators to develop this set of transparencies and accompanying narrative. Returns of questionnaires (Appendix B) indicate that 93 per cent of Washington vocational agriculture teachers have used the previous transparencies during the 1967-68 school year. An additional 2 per cent indicate that they want to use the masters as soon as equipment is available.
INTRODUCTION

Purpose

"Transparency Masters for Teaching Crop Science," is the third study to ascertain the effects of involving teachers in curriculum development. The purpose of this project is to continue to study the effects of involving teachers in development of visual instructional material. This study also explores the value of cooperation between agriculture teacher educators and academic subject matter experts in the development of instructional materials.

Related Research

Vocational teacher supervisors seeking to stimulate curriculum development and use of modernized instructional materials have long recognized the values of involvement. Psychologists and sociologists have researched processes by which involvement increases interest and a sense of identification with new developments and a desire to participate in their use. Curriculum supervisors have explored arrangements and processes designed to enlarge dimensions of participation in developmental processes.

The rationale for this experiment was derived from research indicating the influence of group effort and resultant group relationships on (1) participation, (2) the sense of identification derived from participation, and (3) the effects of participation and personal identification on use of innovations.

The research and observations of Katz and Lazarsfeld\(^1\), Cohen\(^2\), and Sherif and Hovland\(^3\) indicate that cognitive and personal involvement in a process (1) enlarges peoples' sense of identity, (2) increases their comprehension, (3) stimulates purposeful personal effort, and (4) activates a will to pursue purposes derived from consensus of group

\(^{1}\text{Katz, Elihu, and Paul F. Lazarsfeld, Personal Influence, Free Press, 1955.}\)

\(^{2}\text{Cohen, Arthur R., Attitude Change and Social Influence, Basic Books, 1964.}\)

\(^{3}\text{Sherif, Muzafar, and Carl I. Hovland, Social Judgment, Yale University Press, 1961.}\)
thought. Zander and Medow⁴ add evidence that improvements of performance impel individuals and groups to continue sustained efforts to make further improvements.

METHOD

Personal inquiries were made of the state supervisors by the author. Their suggestions were included in the development of the transparencies.

Suggestions from teachers for this third phase of the project were obtained by mail. Fifteen teachers responded to inquiries (See Appendix A). Teacher suggestions as shown in Tables 1 and 2 were used in the development of this series of transparency masters.

TABLE 1

<table>
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Agronomic Areas of Interest Identified by Vocational Agriculture Teachers

<table>
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<td>Root Types</td>
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<td>Cereals</td>
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RESULTS

State supervisor and individual teacher reports indicate a strong and increasing interest in specific instructional aids. Workshops, follow-up questionnaires soliciting the teachers' suggestions for refinement of field tested materials, and the continued involvement of teachers in development and testing of new materials have resulted in development of a substantial number of transparency masters.

Returns of questionnaires (see Appendix B) indicate that 93 per cent of Washington state vocational agriculture teachers have used the masters during the 1967-68 school year. An additional 2 per cent indicate that they want to use the masters as soon as equipment is available.

Fifteen teachers indicated their specific interest in transparencies and slides in an agronomic curriculum (See Tables 1 and 2).
DISCUSSION

This project indicates that the effects of involvement hypothesized on the basis of the research and concepts of Katz, Lazarsfeld, Cohen, Sherif, Hovland, and Zander do materialize. Continued involvement of teachers does seem to increase teachers' interest in cooperative work on instructional materials. The vocational agriculture teachers in Washington state are actively using a variety of instructional media. This pursuit and use of the best instructional materials available plus the involvement of large numbers of teachers in workshop meetings offers promise of keeping vocational instruction applicable to current needs.

RECOMMENDED USES OF MASTERS

Suggested Teaching Strategy

Transparencies can be used in many ways by the agriculture teacher. The transparency masters in this unit are designed to enable the teacher to approach a multi-media system of instruction.

The instructional strategy that includes the technique most appropriate to commonly held objectives for teaching, identification, and classification of economic crops will in the authors' opinion include colored transparencies. For this reason these transparency masters have been duplicated on tracing paper. Tracing paper enables the production of colored transparencies by the Diazo process.5

A colored transparency or slide will most closely approximate the actual conditions necessary for teaching objectives that include discrimination between plant or seed varieties. Living or mounted plant materials would continue to be the primary instructional media and this set of transparency masters would supplement them. These transparencies can be incorporated with slides, programmed instruction, discussion, and demonstrations to provide the instructional manager with more media from which to make choices.

The instructor is expected to provide local application of this instructional material. Transparencies lend themselves to editing. The instructional manager should make timely changes in the transparency masters to update and refine them for his teaching objectives.

Student Participation

These masters lend themselves well to use by students in classroom reports and speech presentations. They permit individual student review or testing.

The masters are additionally appropriate for Future Farmers of America activities, such as TV shows. They provide good raw material for graphic artists to help demonstrate chapter activities.

Narrative Description

The narrative included with this material, Pages 8-16, can be utilized to prepare audio tapes to supplement the transparency masters, or the teacher can use this narrative as a script accompanying the transparencies.

Presentation

The development of this set of transparencies has been based upon a need for limiting the material presented on each transparency and the realities of cost for preparation of each transparency. Lead lines are on one side of the object projected to enable the instructor to use the step method of revealing each item illustrated in the overhead projection transparency. The teacher is encouraged to modify these masters to fit his particular needs. For a review of overhead transparency duplication and usage see "Transparency Masters for Agriculture (Supplement)"6 or any of the many current publications available.

The agriculture teacher is encouraged to design a system of instruction that will serve as the best resource for attaining his objectives. Further development of this "instructional system" may well be implemented by the teacher in the field by developing audio tapes of a field man, or a seed grader or similarly employed agronomy service personnel. This could serve to introduce the vocational opportunities available in the agronomy field. Additional interest will result from this interview of a person whose work demonstrates a need for knowledge of agronomy.

In developing this series of transparencies, our objectives were to illustrate the basic plant parts, their shape, structure, and function which would enable the student to better understand the terminology used to describe specific plant parts used in identification of crops and weeds. To become familiar with the general aspects of plant identification, we recommend coverage of Section I first. The remaining sections may be arranged in any logical order according to the desires of the instructor and his respective learning program.

6Ibid.
While these aids demonstrate the basic principles of plant structure, they are designed only to supplement, rather than replace, actual living or mounted plant specimens. Teachers will find these instructional aids most useful to further the interest and understanding of students for crop and weed identification and other basic agronomic principles. These principles can then be applied to field performance. Utilization of these instructional aids conjugated with living material provide a flexible instructional system.
NARRATIVE

SECTION I: GENERAL PLANT MORPHOLOGY AND IDENTIFICATION

1. The Seed:

Nearly all economic crops grown by the farmer, and the weeds which infest his fields belong to the group of plants called Angiosperms. This group is further subdivided into Monocotyledons, which have one cotyledon or seed leaf per embryo, and Dicotyledons, which have two cotyledons. These two transparencies show vertical cross-section views through a monocot and dicot seed with the important parts of each labeled.

2. Inflorescence Types:

The cluster or arrangement of flowers of a plant is known as an inflorescence. Inflorescence type, shape, and structure are often used to separate and identify various crops and weeds. These transparencies present the five basic inflorescence types: spike, panicle, raceme, head, and umbel.

3. Flower Types:

Seeds of flowering plants begin their development in a structure known as the flower (floret in grasses). The flower, in addition to other structures, contains the sexual parts of the plant, the stamens, (male structures) in which the pollen develops, and/or the pistle, (female structure) which encloses the ovary or developing egg. These transparencies show typical flowers found in monocots and dicots with the important parts labeled.

4. The Legume Flower:

Legumes are dicotyledons and many have a very distinct flower type as shown on this transparency. The five petals (calyx) of this flower are irregular in shape and form the five basic parts.
5. The Wheat Spikelet:

Grass plants are monocotyledons having a much reduced and modified flower. The sepals and petals have been reduced to papery bracts. This transparency shows the basic parts of a typical grass flower in such a way that they may be put together to form a multiple type transparency.

6. Meristematic Region:

Meristematic regions are those areas where cell division occurs and where plant growth is initiated. In woody and herbaceous dicots this region is at the tip of the developing shoot. In monocots, growth is initiated in an area just above the last developed node on the stem. These two types are illustrated in this transparency with regions labeled.

7. Sheath and Ligule Types:

Most grasses can be identified by basic structural differences. Some vegetative differences are noted in ligule shape and size, and in the type of leaf sheath. These characteristics when coupled with such things as leaf shape, texture, auricle size, pubescence, and other vegetative characteristics can serve to identify many of the grasses. This transparency shows some basic vegetative characteristics found in many of the various grass plants.

8. Specialized Stems:

In some plants, stems have been modified to provide for asexual reproduction or propagation. If the stem creeps above the ground, developing roots and shoots at the point (nodes) where it touches the ground, it is known as a stolon. If the stem develops underground, and roots and shoots arise from the nodes, it is known as a rhizome. Many difficult weeds to control, as well as grasses and legumes, spread by rhizomes and stolons. These transparencies show the differences in their formation and are labeled to show the main parts.
9. **Leaf Types:**

All plants have characteristic leaf types which aid in their identification. Once a general leaf type has been identified, many other characteristics of the individual leaf are utilized for final identification. Several basic leaf types appear in these transparencies.

10. **Legume Leaf:**

Legumes are important agronomic plants having trifoliolate leaves consisting of three leaflets. This is the primary leaf characteristic of the true clovers, sweetclover, and alfalfa. This transparency shows a typical legume leaf with parts labeled.

11. **Grass Leaf:**

Grasses are the most important agronomic plants belonging to the narrow-leaved group. Most grass leaves have only one blade with the other parts being highly modified from that of a typical broad leaf. A type grass leaf is diagrammed in this transparency.

12. **Root Systems:**

Most plants have either a fibrous root system as found in the grasses, or a tap root system such as that of many legumes. These transparencies describe the principle differences between these two types of root systems.

SECTION II: CEREAL CROP IDENTIFICATION

1. **Leaf Vegetable Characteristics of Cereal Grains:**

This transparency shows several important characteristics which aid in separating the more common cereal plants. These features can be used at a very early growth stage before heading.

2. **Morphology of the Wheat Seed:**

This series of transparencies shows in diagrammatic form the general morphological and structural characteristics of the wheat kernel.
3. Market Classes of Wheat:

Wheats can successfully be identified as to market class by kernel shape and structure, and by brush, check, and crease types. These transparencies illustrate seed characteristics common to the various wheat market classes.

4. Oat Seed:

This transparency shows the main identifying characteristics between cultivated and wild oats with parts labeled.

5. Barley:

This transparency illustrates the major differences between 2-rowed and 6-rowed barley seed. This difference is difficult to recognize at first but it can be observed with practice.

6. Rye:

The factors distinguishing rye from wheat are noted in this transparency.

SECTION III: LEGUME IDENTIFICATION

These transparencies are designed to show the leaf characteristics, stipule shape and size, and other recognizable features of the fully developed legume leaf for several common forage types.

A drawing of the seedling is included to show early structural differences at the first trifoliolate leaf stage. There are no parts labeled in these drawings because labels in Section I for the typical legume leaf are applicable here.

1. Alfalfa:

The terminal leaflet of the trifoliolate leaf is supported on an elongated stalk (petiolar branch) and the margin is serrated at the tip.

7 The soft red winter overlay can be used for soft white wheat.
2. Sweetclover:

The terminal leaflet of the trifoliolate leaf is supported on an elongated stalk, and the leaflet is serrated along 2/3 of its margin.

3. Red Clover:

Leaflets are sessile on the petiole representing a true trifolium leaf. Leaflets are large, pubescent along the margin, and have a light-colored water mark. The tips of the leaflets are usually pointed. Stipules are large and heavily purple veined. Petioles are heavily pubescent.

4. White Clover:

Sessile leaflets arise on a long petiole from a prostrate stem (stolon). The leaflet is heart shaped or notched at the tip and has a light-colored water mark. Vegetative parts are not pubescent.

5. Alsike Clover:

Sessile leaflets are minutely serrated around the entire margin and are very finely veined. Stipules are long and taper at the tip with light green or white-colored veins. No pubescence is evident on vegetative parts.

6. Strawberry Clover:

Sessile leaflets without water marks are borne on long petioles from a creeping stem (stolon). Leaflets have thick parallel veins which are conspicuous at the margin. Pubescence of vegetative parts is usually lacking.

7. Subterranean Clover:

Sessile leaflets arise from short petioles from a prostrate stem (stolon). The leaflets are notched at the tip, heart shaped, and pubescent. A water mark is lacking, and the leaves and stems are softly pubescent.
8. Crimson Clover:

Sessile leaflets arise from an upright stem on long petioles, and they lack a water mark. Both leaflets and petiole are pubescent. Stipules are large, broad, and with distinct purple margins.

9. Hairy Vetch:

Leaves are pinnately compound and contain 10 to 20 leaflets alternately arranged on a central axis. Tendrils are present. Petioles, axis, and leaflets hairy or highly pubescent.

10. Birdsfoot Trefoil:

In this legume there are actually three leaflets per leaf, however, the stipules resemble leaves presenting the appearance of five leaflets, three apical and two basal. Pubescence of vegetative parts is lacking.

SECTION IV: GRASS IDENTIFICATION

These transparencies show the inflorescence, spikelet, and a dorsal-ventral view of the caryopsis for several grass types. The most easily observed characteristics were drawn as outline sketches with much elimination of detail. The spikelet and seeds illustrated are enlarged to fully demonstrate several minute identifying features. Observation of living material should accompany these transparencies, to gain experience in recognizing the various points as they actually exist. Many of the following features are difficult to see and can be mastered only with considerable practice and observation.

1. Kentucky Bluegrass:

Panicle is open with lower branches in whorls of five. The spikelet contains many florets and is much flattened, resulting in compressed seeds. Seeds have a thin hood projecting around the upper half of the seed, and webbing, representing sterile florets, may be present at the base.
2. Big Bluegrass:

Panicle is much tighter than Kentucky bluegrass but is larger in overall size with the spikelet less compressed and more open. The seed shows a thin hood extending around its upper portion and is toothed along the back rib.

3. Bulbous Bluegrass:

Seed is lacking and replaced by bulblets, which are often bluish to purple in color. Matures very early in the spring. Bulbs develop rapidly into new plants, since seed germination is eliminated. Inflorescence is a panicle.

4. Smooth Bromegrass:

Panicle is more open with spikelets long, narrow, and tight usually containing 3-6 seeds. The seed is very flat and papery, with a blunt tip, and with a small awn at the apex. The rachilla is large and pubescent.

5. Mountain Bromegrass:

The spikelet is large and may be sticky. The seed is long, narrow, and sharp tipped with a long awn. The leaf may be very harsh and prickly to the touch.

6. Tall Fescue:

The inflorescence, a panicle, is larger than red fescue with tighter spikelets. The seed is boat shaped with a knobbed rachilla and with spines along the veins of the lemma.

7. Red Fescue:

The spikelet is open and rather large. The seed is boat shaped with a short awn. The inner edge of the palea is toothed, and the lemma is smooth. A knobbed rachilla is present.

8. Orchardgrass:

The spikelet is small, very dense, and develops in tight clusters within the panicle. The seed is curved with fine hairs along the mid vein of
8. Orchardgrass: (Continued)

the lemma, terminating in a short curved awn. Rachilla is present, but not knobbed. Stems are much flattened, especially at the base.

9. Intermediate Wheatgrass:

The inflorescence is a spike. Spikelets are loosely structured and arranged flatwise to the rachis, that is, the wide side of the spikelet faces the rachis of the spike. The seed has a small awn and a slightly knobbed rachilla. The palea has minute spines around the inner margin.

10. Crested Wheatgrass:

The inflorescence is a spike usually in the shape of a pyramid. The seed has a short, broad rachilla, a toothed inner margin on the palea, and a spiny keel with a curved awn.

11. Perennial Ryegrass:

The inflorescence is a spike, with spikelets arranged edgewise (in contrast to flatwise) to the rachis. The second glume is absent or compressed into the rachis leaving the appearance of only one glume per spikelet. The seed is boat shaped with a wedge-shaped rachilla and the inner margin of the palea is minutely toothed. Seed is similar to tall fescue in color and size except the rachilla is not knobbed.

12. Tall Oatgrass:

The inflorescence is a large open panicle with one spikelet per pedicle. The spikelet contains two florets one of which is usually sterile. The awn is similar to that of wild oats--twisted and bent at the tip.

13. Reed Canarygrass:

The inflorescence is quite dense and large with spikelets containing only one seed. The seed is shiny with minute hairs at the tip which may drop off as the seed dries.
14. Redtop:

The inflorescence is a definite pyramidal, open panicle which turns red with maturity. The glumes completely enclose the florets. The seed is small, narrow, pointed, and with no apparent rachilla. A tuft of fine hairs may be present at the base of the seed.

15. Timothy:

The inflorescence is a very dense panicle and often resembles a cylindrical spike. The glumes are pronounced, awned and have minute teeth around the outside edge at the tip. Only one seed is contained within each pair of glumes.

SECTION V: WEED IDENTIFICATION

The following transparencies show the identifying plant and seed characteristics of several weeds in diagrammatic form. These drawings are intended only to demonstrate the features of various weeds and should be supplemented by examination of living plant specimens to become competent in weed identification. Specific descriptions related to identification of each weed appears on each of the following transparencies of this series.
GENERAL PLANT MORPHOLOGY AND STRUCTURE

SECTION I

TRANSPARENCY MASTERS FOR CROP AND WEED IDENTIFICATION

Dwane G. Miller  Gilbert A. Long  Clarence E. Manning

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MONOCOT SEED

(COTYLEDON)

(PLEOPTILE)

(EPICOTYL)

(RADICLE)

(L.S.)
INFLORESCENCE TYPES

23
INFLORESCENCE TYPES
TYPICAL DICOT FLOWER
TYPICAL MONOCOT FLOWER
WHEAT SPIKELET

CARYOPSIS
MERISTEMATIC REGIONS

GRASS STEM

ALFALFA STEM
COMMON SHEATH AND LIGULE TYPES
STOLON: A SPECIALIZED STEM
RHIZOME: AN UNDERGROUND STEM
SIMPLE PALMATELY COMPOUND LEAF
SIMPLE PINNATELY COMPOUND LEAF
TYPICAL TRIFOLIOLATE LEGUME LEAF
NARROW GRASS LEAF
TAP ROOT SYSTEM

Diagram of a tap root system.
RADICLE

PRIMARY
ROOT

SECONDARY
ROOTS

DEEP, PENETRATING
ROOT SYSTEM
FIBROUS ROOT SYSTEM
RADICLE

PRIMARY ROOT

SECONDARY ROOTS

SHALLOW, SPREADING ROOT SYSTEM
CEREAL CROPS

SECTION II

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AURICLE LACKING
PUBESCENCE
LACKING

BARLEY
LONG AURICLE
PUBESCENCE
ON COLLAR

CORN
AURICLE LACKING
LIGULE MINUTE

WHEAT
MEDIUM AURICLE
PUBESCENCE ON
AURICLE

RYE
SHORT AURICLE
PUBESCENCE ON
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BRUSH LENGTHS
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KERNEL SHAPES
HARD RED WINTER WHEAT
HARD RED SPRING WHEAT
LONG, POINTED BRUSH WITH A DEFINATE RING

LARGE GERM

SHORT, PLUMP KERNEL

MIDDEEP CREASE

ANGULAR CHEEKS

BACK RIDGE OFFSET WITH DIMPLE
SOFT RED WINTER WHEAT
BRUSH MIDLONG
DEFINATE RING

BARREL
SHAPE
KERNEL

OPEN
CREASE

LARGE
GERM

WIDEST
AT
MIDDLE

ROUNDED
CHEEKS

ROUND, SOMETIMES
WRINKLED BACK
WHITE CLUB WHEAT
BRUSH MIDLONG
SOMETIMES
POINTED

VERY IRREGULAR
SHAPE KERNEL

MIDSIZE
GERM

MIDDEEP
CREASE

ROUNDED
CHEEKS

HUMP BACK
NEAR GERM
AMBER DURUM WHEAT
BRUSH VERY SHORT OR LACKING

LONG KERNEL

DEEP CREASE

LONG POINTED GERM

ANGULAR CHEEKS

HIGH RIDGE DOWN BACK
RED DURUM WHEAT
BRUSH LACKING

WIDEST NEAR TIP END

MIDDEEP CREASE

SHARP POINTED GERM

ANGULAR CHEEKS

ROUNDED BACK

86
OAT SEED
BARLEY
2-ROW

ALL KERNELS ARE STRAIGHT

6-ROW

2/3 OF THE KERNELS ARE BENT DUE TO CROWDING AT RACHIS JOINT
TETRA PETCUS
DEEP, OPEN CREASE
LARGE, POINTED GERM
RIDGE ON BACK
SHORT BRUSH

BALBOA
SHALLOW, TIGHT CREASE
LARGE, POINTED GERM
SMOOTH BACK
SHORT BRUSH
LEGUMES

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TRANSPARENCY MASTERS FOR CROP AND WEED IDENTIFICATION

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SEEDLING

MATURE LEAF
SWEETCLOVER

SEEDLING

MATURE LEAF
RED CLOVER

SEEDLING

MATURE LEAF
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SEEDLING

MATURE LEAF
STRAWBERRY CLOVER

SEEDLING

MATURE LEAF
SUBTERRANEAN CLOVER

SEEDLING

MATURE LEAF
Hairy Vetch

Seedling

Mature Leaf
BIRDSFOOT TREFOIL

SEEDLING

MATURE LEAF
GRASSES

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PROSPECTIVE VIEW OF THE VARIOUS PARTS OF THE GRASS INFLORESCENCE SHOWING LEVELS OF DEVELOPMENT.

INFLORESCENCE

SPIKELET: A UNIT OF THE INFLORESCENCE

VENTERAL VIEW

DORSAL VIEW

CARYOPSIS (SEED)
BIG BLUEGRASS

INFLORESCENCE

SPIKELET

SEED

110
BULBOUS BLUEGRASS

INFLORESCENCE

BULBLET

BULB
SMOOTH BROME GRASS

INFLORESCENCE

SPIKELET

SEED
ORNAMENTAL GRASS

INFLORESCENCE

SPIKELET

STEM

SEED

121
PERENNIAL RYEGRASS

INFLORESCENCE

SPIKELET

SEED
TALL OATGRASS

INFLORESCENCE

SPIKELET

SEED

FLORET
REED CANARYGRASS

INFLORESCENCE

SPIKELET

SEED

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CANADA THISTLE

LEAF

SEED
CANADA THISTLE

(Cirsium arvense (L.) Scop)
Cursed thistle, Devil's thistle

Rose-purple flowers

Leaves irregular, deeply cut relatively smooth to spiny margins

Both male and female flowers

Plant erect branching near the top

Grows 2 to 7 feet high

Reproduces by seed and by underground rootstocks

Perennial
DALMATIAN TOADFLAX

LEAF

SEED
DALMATIAN TOADFLAX
(Linaria Dalmantica)

- Bright yellow flowers tinged with orange
- Flowers look like those of cultivated snapdragons
- Upper leaves more heart shaped and clasp the stem
- Grows 1 to 4 feet high
- Reproduces by seed and underground rootstocks
- Perennial
LEAFY SPURGE

LOWER LEAF

UPPER LEAF

CAPSULE

SEED

142
LEAFY SPURGE
(Euphorbia esula (L.) Hill)

 Entire top portion of plant may appear yellowish green at this stage

 Leaves, alternate, narrow and lace-like

 Seeds borne in a three-lobed capsule

 Entire plant has a milky juice

 Reproduces by seed and underground rootstalks

 Perennial
QUACKGRASS

INFLORESCENCE

SPIKELET

SEED
QUACKGRASS

(Agropyron repens (L.) Beauv.)
Couchgrass, Devil's grass

Inconspicuous flowers

Grows 1 to 4 feet tall

Leaves are somewhat rough

Lower leaf sheaths are somewhat hairy

At base of each leaf a small pair of claws (auricles) clasp the stem

Forms dense mat of white to straw-colored rootstocks

Perennial
RUSSIAN Knapweed

LOWER LEAF

UPPER LEAF

CAPSULE

SEED
RUSSIAN Knapweed

(Centaurea repens Pall.)

Light purple flowers

Seed heads scaly and do not open up at maturity

Upper leaves simple, small and linear

Lower leaves larger and deep notched and covered with downy white hairs

Roots are usually dark brown or black

Entire plant has a lingering bitter taste

Reproduces by seeds and rootstocks

Perennial
SKELETON WEED

BASAL LEAF

UPPER LEAVES

SEED
WHITE TOP

(Cardaria draba)
Hoarycress, Perennial peppergrass

Creamy-white flowers

Seed pods flattened and heart-shaped

Upper stem branches profusely

Upper leaves clasp the stems

Leaves greyish-green

Reproduces by seed and rootstocks

Perennial
WILD MORNING-GLORY

LEAF

SEED
WILD MORNING-GLORY

(Convolvulus arvensis L.)
Field bindweed, Creeping jenny, European bindweed

White to pinkish, funnel-shaped flowers

Leaf size and shape may vary somewhat but are essentially heart or arrow-shaped

Has 2 bracts about midway on flowering stalk

Stems are prostrate or twining

Reproduces by seed and underground rootstalks

Perennial
BUCKHORN PLANTAIN

PLANT

SEED

153
BUCKHORN PLANTAIN
(Plantago lanceolata)
Buckhorn, Ribgrass

Resembles timothy head

Seed brown, canoe-shaped

3 to 5 prominent veins

Long, narrow lance-shaped leaves

Basal leaves

A tuft of brown hairs are at the base of each leaf

Perennial
DODDER
(Cuscuta sp.)
Devil's hair, Field dodder

- Small whitish flowers
- Stems hair-like yellow to reddish
- No leaves
- Yellowish seed, remain viable five years or more
- Plant is parasitic, ground stem soon breaks off
CURLY DOCK

LEAVES

SEED

CROSS SECTION

157
CURLY DOCK
(Rumex crispus L.)
Curled dock, Indian tobacco, Sour dock

- Flowers form a triple winged pod
- Reddish brown at maturity
- Upper leaves clasp-ing and less wavy than the lower leaves
- Lower leaves 6 to 8 inches long and wavy
- Reproduces by seed
- Perennial having a deep taproot
FANWEED

LEAVES

CAPSULE

SEED
FANWEED

(Thlaspi arvense L.)
Pennycress, Frenchweed, Stinkweed

White flowers

Seed pods flat, winged and notched at the top

Seed pods turn light brown to nearly yellow at maturity

Leaves alternate and clasp the stem

Plant grows one to three feet tall

Annual
KLAMATH WEED

LEAVES

SEED

161
GOATWEED
(Hypericum perforatum L.)
Klamath weed, St. Johnswort

- Yellow to orange
- Opposite leaves
- Holes in the leaves
- Short underground stems
- Shallow-rooted perennial
PUNCTURE VINE

LEAF

SEED
163
PUNCTURE VINE

(Tribulus terrestris L.)
Mexican sandbur, Texas sandbur

- Yellow flower
- Each leaf is composed of several pairs of leaflets
- Seed pods contain 5 spiny burs, they readily separate
- Covered with dense silky hairs
- Much branched prostrate plant radiating from taproot
- Reproduces by seed
- Annual
SHEEP SORREL

LEAF

SEED
SHEEP SORREL
(Rumex acetosella L.)
Sourgrass, red sorrel

Reddish color
Grows 6 to 24 inches tall
Leaves are arrow-shaped
Plant sour taste
Dense rosette at base of plant
Shallow rooted
Perennial
WILD OATS
(Avena fatua L.)
Oatgrass

Resembles tame oats but has a more open head or panicle

Blackish, twisted and bent awns

Seeds tend to shatter at maturity

Seeds have a "sucker mouth" and a hairy rachilla

Reproduce by seed

Annual
YELLOW STARTHISTLE
(Centaurea solstitialis L.)

Yellow flowers

Flower heads are armed with long yellow spines

Stems and leaves are somewhat white-ened with a loose cottony fuzz

Upper leaves are entire and sharp pointed

Lower leaves are larger and deeply lobed

Reproduces by seed

Annual
BLACK NIGHTSHADE
(Solanum nigrum)
Garden nightshade, Deadly nightshade

Small, white flowers produced in clusters

Berries are round and smooth, turn black when ripe

Plant often found in peas, stubble fields, and in the summer fallow

Plant freely branching and bushy

Reproducing by seed

Annual
BACHELORS BUTTON

LEAVES

SEED

173
COW COCKLE

LEAVES

CAPSULE

SEED
COW COCKLE
(Vaccaria vulgaris Host.)

Pinkish red flowers
Calyx five angled
Stem forked branching
Leaves opposite and clasp the stem
Reproduces by seed

Annual
BULL THISTLE

LEAF

SEED
BULL THISTLE
(Cirsium lanceolatum)
Common thistle, Roadside thistle

Purple to pink flowers
Rosette growth stage first year growth
Upper leaf surface green
Under surface finely haired
Prickly stalk
Biennial

Alauerns
DOG FENNEL

LEAF

SEED
DOG FENNEL

(Anti-émis cotula L.)
Mayweed, Field camomile

Petals white, centers yellow

Leaves light green and finely divided

Plants have a bitter taste and an unpleasant odor

Plant branched growing from 1 to 3 feet tall

Reproduces by seed

Annual
DOWNY BROMEGRASS
(CHEAT)

INFLORESCENCE

SPIKELET

SEED 180
CHEATGRASS
(Bromus tectorum L.)

Head loose and nodding

Grows 6 to 24 inches tall

Seeds contain a long rough awn or beard

Turns reddish purple upon maturing

Leaves covered with soft hairs

Annual
GROMWELL

LEAVES

SEED
HENBIT

LOWER LEAVES  UPPER LEAVES

SEED  183
HENBIT
(Lamium amplexicale L.)
Dead nettle

Pink to purplish tubular flowers

Upper leaves clasp the stem and are rounded and lobed

Stems are semi-prostrate with upright numerous branches

Entire plant may take on a purplish color

Reproduces by seed

Annual or biennial
JIM HILL MUSTARD

LEAVES

SEED

185
JIM HILL MUSTARD
(Sisymbrium altissimum)
Tumbling mustard

- Light yellow to yellowish white flowers
- Seed pods 2 to 4 inches long set on a stem approximately 1/4 inch long
- Upper leaves are narrow, linear, segments
- Lower leaves are large, deeply lobed and somewhat hairy

Reproduces by seed
Annual
KNOTWEED

LEAF

SEED

187
PROSTRATE KNOTWEED
(Polygonum abiculare L.)
Knotgrass, Matweed

Forms a mat especially in hard or trampled areas (driveways, along walkways, etc.)

Leaves have a dull bluish green color and are sometimes covered with a white mildew

Flowers are small, yellow inconspicuous, borne in the axils of the leaves and stems

Plant is tough, drouth resistant and can survive a great deal of abuse

Reproduces by seeds

Annual

188
LAMBS-QUARTERS

UPPER LEAF

LOWER LEAF

SEED
LAMBS-QUARTERS
(Chenopodium album L.)
Pigweed

- Flowers in clusters, green and inconspicuous
- Leaves covered with white mealy substance
- Leaves have irregular toothed margins
- Stems smooth, often striped with pink or purple and are usually ridged and grooved

Plant grows from 1 to 6 feet high

Reproduces by seed

Annual
MALLOW

LEAF

SEED

191
MALLOW
(Malva rotundifolia L.)
Buttonweed, Cheeseweed

White flowers

Leaves round with the edges slightly lobed

Stems somewhat prostrate extending from the crown

Has a deep taproot

Reproduces by seed

Annual, biennial and possibly perennial
MARES-TAIL

LEAF

SEED
193
MARES-TAIL

(Erigeron canadensis L.)
Canada fleabane, Horseweed

Flowers, many small white

Grows 2 to 5 feet high

Leaves alternate and rough to the touch

Upper leaves entire and linear

Lower leaves serrate

Leaves and stems hairy

Reproduce by seed

Annual
PRICKLY LETTUCE

LEAF

SEED
CHINA LETTUCE
(Lactuca scariola L.)
Prickly lettuce, Wild lettuce

- Light yellow flowers
- Upper leaves clasping
- Leaves often take quarter turn
- Midrib on under side of leave lighter color and lined with spines
- Milky juice
- Annual
ROUGH PIGWEED

LEAF

SEED

197
PIGWEED

(Amaranthus retroflexus L.)

Redroot

Dense prickly clusters of inconspicuous flowers

Leaves somewhat eggshaped, attached to stem with a long petiole

Rough somewhat hairy central stem

Reddish-pink root

Reproduces by seed

Annual
RUSSIAN THISTLE

YOUNG LEAF

MATURE LEAF

SEED
RUSSIAN THISTLE

(Salsola pestifer A. Nels)

Tumbleweed

Light pink to green (inconspicuous) flowers produced in the axils of leaves and stems

Young plants are succulent and fleshy

Extensively branched, bushy growth

Purple or reddish strips on stems

Pest becomes stickery at maturity

Annual
SALSIFY

LEAF

SEED

201
WILD SALSIFY
(Tragopogon pratensis L.)
Oyster plant, Goatsbeard

Yellow or purplish blue flower

Seed head forms large white puff ball

Leaves long and linear almost "grass-like"

Plant smooth and contains a bitter, white milky juice

Plant has a deep fleshy taproot

Reproduces by seed

Biennial
TARWEED

LEAF

SEED

203
TARWEED
(Amsinckia intermedia F and M)
Fiddleneck

Yellow flowers

Gooseneck flower stalk

Plant covered with hairs

Entire plant rough and stickery

Leaves dull green to grayish

After maturity plant becomes a dull gray

Annual
WILD BUCKWHEAT

LEAF

SEED

205
WILD BUCKWHEAT
(Polygonum convolvulus)
Black bindweed

Flower inconspicuous borne in clusters on flower stalks

Leaves arrow or heartshaped

Stems long, twining or trailing

Reproduces by seed

Annual
YARROW

LEAF

SEED

207
YARROW

(Achillea millefolium L.)
Milfoil, Thousand-leaf

White

Grows 1 to 2 feet tall

Covered with fine hairs

Fine fern-like leaves

Perennial
HAIRY VETCH

LEAF

SEED
APPENDIX A

This letter is being sent state-wide to the Vocational Agriculture departments in Washington. Would each of you consider for a moment what visual aids would be most beneficial to you in your respective Agronomy or Crops teaching programs. Coordinated efforts between the Agronomy Department and Division of Agricultural Education at WSU are being attempted in hopes of compiling visual aids for instructional use in the field of Agronomy. These aids may be in the form of 2 x 2 slides, transparencies, charts, workbooks, etc.

The purpose of this letter is to ascertain which areas of Agronomy should be emphasized based on the major requests of this survey. In this way visual aids of the most significance can be prepared.

As an example one area which may be applicable, would be 2 x 2 slides and transparencies regarding crop seed judging and identification characteristics of crops appearing on the state identification list. These could include diagrams or actual photos of seed quality, seed damage and other factors used in pan seed judging. Slides could be prepared of crop and weed seeds and seedlings for identification purposes. Other areas which can be diagrammed quite well by visual aids are the overall plant growth pattern and plant reproduction as pertaining to crop species.

Please compile your list in order of preference of about ten general headings in the Agronomic field and forward to the following address as soon as possible:

Gilbert A. Long, Agricultural Education
Washington State University, Pullman, Washington 99163

Let me suggest that you look at the two transparency master publications as you consider this request. Any transparency masters that you have individually developed would be welcomed.

Sincerely yours,

Dwane G. Miller
Assistant Professor of Agronomy

Gilbert A. Long
State Supervisor
Agricultural Education

DGM/GAL:sa

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APPENDIX B

Questionnaires Sent to Teachers to Obtain Evidence Regarding Usefulness of Masters

Dear __________________:

Have you used masters from "Transparency Masters for Agriculture (Supplement)"?

YES _________

NO __________

Do you have dry copy equipment available?

YES _________

NO __________

Do you have Diazo process equipment available?

YES _________

NO __________

Which areas have you used most often?

Soils and Fertilizers

YES _________

NO __________

Horticulture

YES _________

NO __________

Animal Reproduction

YES _________

NO __________

Feeding

YES _________

NO __________

Arc Welding

YES _________

NO __________

Future Farmers of America

YES _________

NO __________

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