

# DOWNY BROME SEED GERMINATION

J. A. YOUNG, CHARLIE D. CLEMENTS, AND DAN HARMON  
USDA, AGRICULTURAL RESEARCH SERVICE  
920 VALLEY ROAD, RENO, NV 89512 E-MAIL

HAVING REACHED THE 40<sup>TH</sup> ANNIVERSARY OF THE INITIATION OF OUR RESEARCH ON  
THE SEED AND SEEDBED ECOLOGY OF DOWNY BROME (*BROMUS TECTORUM* L.)  
(YOUNG ET AL. 1969),

WE OFFER A STATE-OF-THE-SCIENCE REVIEW.

## INTRODUCTION

DOWNY BROME IS A VERY SERIOUS WEED IN CEREAL GRAIN PRODUCTION IN THE UNITED STATES (YOUNG AND CLEMENTS 2004). IN THE SHRUB/BUNCHGRASS RANGELANDS OF THE INTERMOUNTAIN AREA, DOWNY BROME IS MORE THAN AN INVASIVE WEED, IT IS AN EXOTIC PLANT THAT HAS CHANGED THE APPEARANCE, PRODUCTIVITY, AND PLANT SUCCESSION ON MILLIONS OF HECTARES OF RANGELANDS (Figure 1).

THE INHERENT CAPACITY OF DOWNY BROME TO MORE EFFECTIVELY UTILIZE SOIL MOISTURE HAS LED TO THE WEED TRUNCATING SUCCESSION AND THEREFORE NOT ALLOWING THE SEEDLINGS OF NATIVE PERENNIAL SPECIES TO BECOME ESTABLISHED (EVANS ET AL. 1960). THE FINE TEXTURED, ABUNDANT, EARLY MATURING HERBAGE OF DOWNY BROME HAS INCREASED THE CHANCE OF IGNITION AND RATE OF SPREAD OF WILDFIRES AS WELL AS EXTENDING THE WILDFIRE SEASON MUCH EARLIER IN THE SUMMER. THIS RESULTS IN A GREATLY REDUCED INTERVAL BETWEEN WILDFIRES AND INSURES THE CONVERSION OF SHRUB/BUNCHGRASS COMMUNITIES TO ANNUAL GRASSLANDS (Figure 2).

## SEED ECOLOGY

PRIOR TO THE INITIATION OF THIS RESEARCH PROJECT, IT WAS WIDELY ASSUMED THAT DOWNY BROME DID NOT DEVELOP SEEDBANKS ON RANGELANDS (KLEMMEDSON AND SMITH 1964). THIS ASSUMPTION DEVELOPED BECAUSE THE SEEDS OF DOWNY BROME ARE HIGHLY VIABLE AND READILY GERMINATE. IT WAS THOUGHT THAT, THE LACK OF DORMANCY PRECLUDED THE POSSIBILITY FOR DEVELOPING SEEDBANKS WITH DORMANT SEEDS.

WE DETERMINED THAT DOWNY BROME SEEDS ACQUIRED A DORMANCY IN THE FIELD (YOUNG ET AL. 1969). IT WAS ALSO DETERMINED THAT DOWNY BROME SEEDS COULD REMAIN DORMANT IN SEEDBEDS FOR AT LEAST 3 YEARS. THIS RESEARCH WAS FACILITATED BY USING HERBICIDES AS A TOOL IN ECOLOGICAL RESEARCH. THE PHYSICAL LOCATION AND STRUCTURE OF SEEDBANKS IN THE RANGELAND SEEDBEDS WAS DETERMINED. (Figure 3). IT WAS DETERMINED BY MONITORING THE MICRO-ENVIRONMENT OF SEEDBEDS THAT DOWNY BROME SEEDS REQUIRED BURIAL IN THIS SOIL, PLACEMENT IN RELATIVELY DEEP DEPRESSIONS IN THE MICRO-TOPOGRAPHY OF THE SURFACE OF THE SEEDBED, OR COVERED BY LITTER IN ORDER TO GERMINATE (YOUNG ET AL. 1969; EVANS AND YOUNG 1970, 1972). DOWNY BROME IS A TREMENDOUS SEED PRODUCER, PRODUCING MANY MORE SEEDS IN THE ANNUAL SEED RAIN THAN ARE REQUIRED TO MAINTAIN A FULLY STOCKED STAND. MUCH OF THE LITTER ON THE SOIL SURFACE IN ESTABLISHED DOWNY BROME STANDS IS COMPOSED OF DOWNY BROME CARYOPSES. NOT ALL OF THESE CARYOPSES FIND SAFESITES FOR GERMINATION AND RATHER THAN BECOMING NON-VIABLE, THEY ACQUIRE A DORMANCY (Figure 4).



Figure 1. INVASION BY DOWNY BROME HAS CHANGED THE APPEARANCE, SPECIES COMPOSITION, AND PRODUCTIVITY OF MILLIONS OF HECTARES OF SHRUB/BUNCHGRASS RANGELANDS IN THE INTERMOUNTAIN AREA OF NORTH AMERICA.



Figure 2. DOWNY BROME HAS CHANGED THE INTERMOUNTAIN AREA BY PROVIDING AN EARLY MATURING, FINE TEXTURED FUEL THAT INCREASES THE CHANCE OF IGNITION AND RATE OF SPREAD OF WILDFIRES. A PORTION OF THE MIDAS FIRE IS SHOWN. IT OCCURRED IN 1999 WHEN 600 THOUSAND HECTARES BURNED IN A 10 DAY PERIOD.

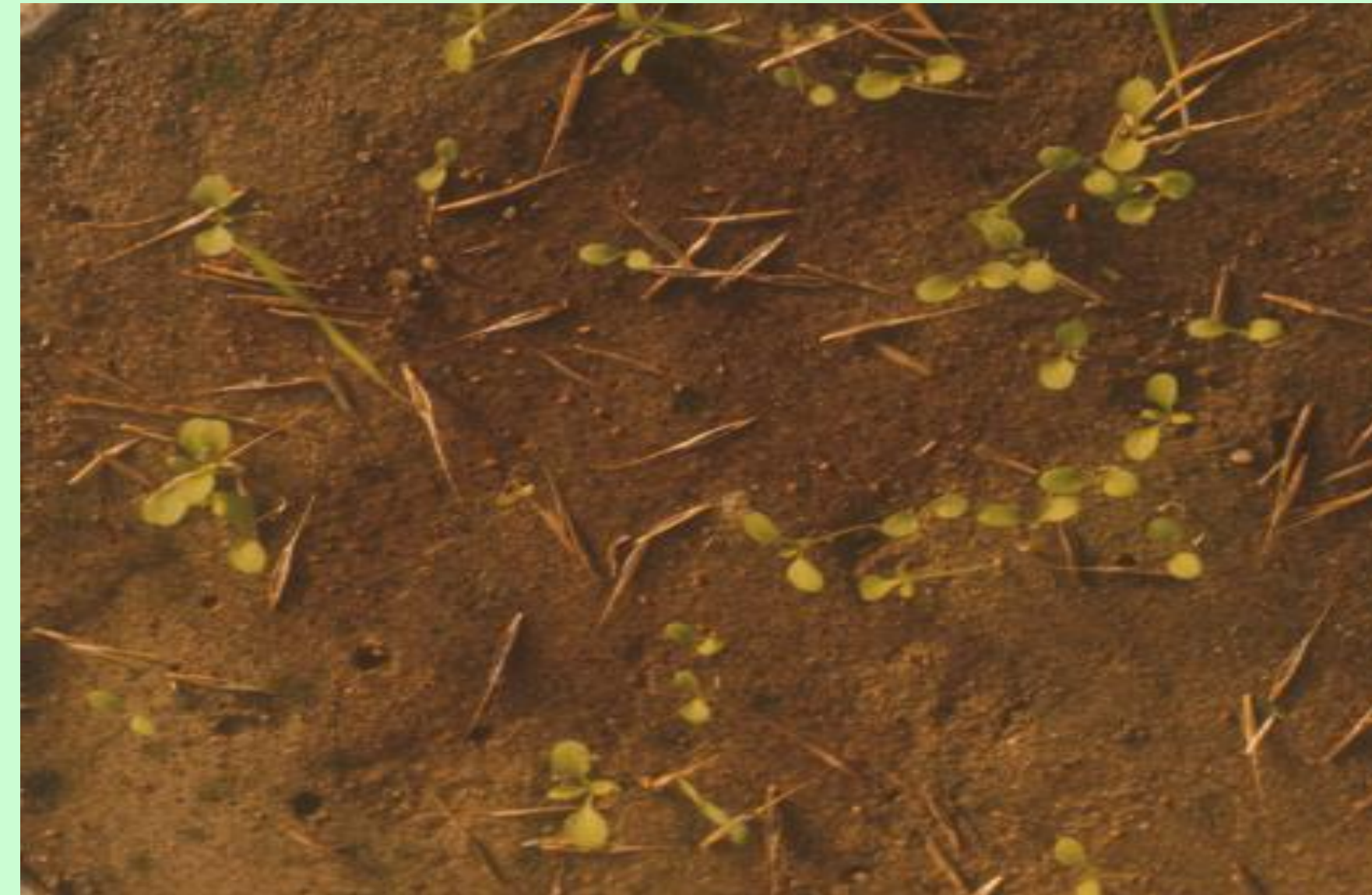


Figure 4. YOU CAN DEMONSTRATE THE RELATIVE SAFESITE REQUIREMENTS FOR GERMINATION OF DOWNY BROME SEEDS BY PLACING SEEDS ON THE SURFACE OF A SILT-LOAM TEXTURED SOIL IN THE GREENHOUSE WITH SEEDS OF TUMBLE MUSTARD (*SISYMBRIUM ALTISSIMUM*). THE MUCILAGINOUS SEED COATS OF THE TUMBLE MUSTARD ALLOW FOR GERMINATION ON THE SOIL SURFACE WHILE THE MAJORITY OF THE DOWNY BROME SEEDS REMAIN UNGERMINATED (YOUNG ET AL. 1970)

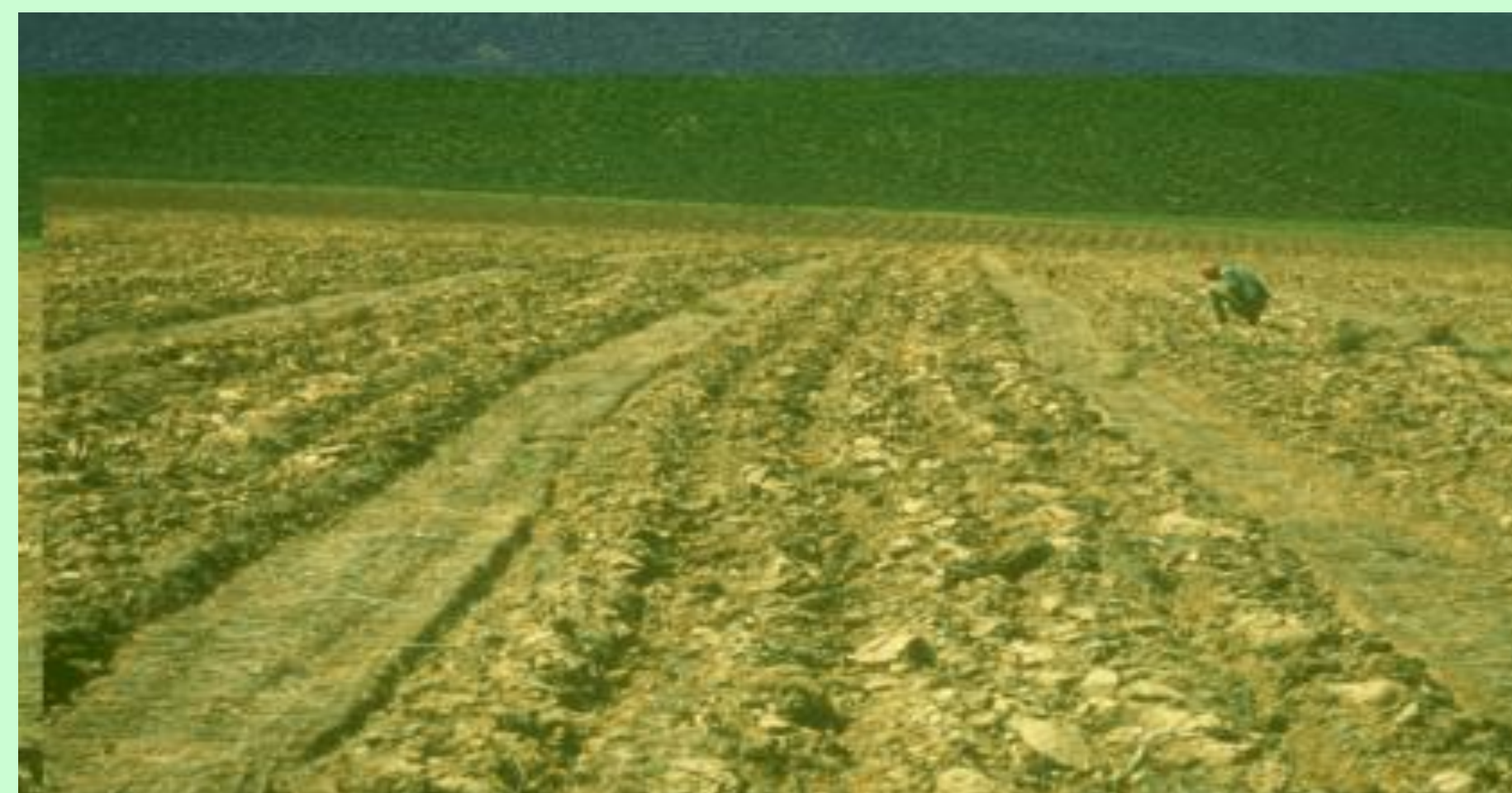


Figure 5. PRACTICAL APPLICATION OF SEEDBED AND SEED ECOLOGY OF DOWNY BROME ON RANGELANDS. HERBICIDAL FALLOW RESULTED IN THE LOSS OF LITTER FROM THE SOIL SURFACE. THIS LIMITED THE GERMINATION OF DOWNY BROME SEEDS FROM THE SEEDBANK. PERENNIAL GRASS SEEDS WERE PLACED IN A FAVORABLE ENVIRONMENT FOR GERMINATION AND SEEDLING GROWTH IN DEEP FURROWS.



Figure 3. ON RANGELANDS WHERE SOILS ARE NOT TILLED, SEEDBANKS FOR DOWNY BROME OCCUR ON THE SOIL SURFACE IN THE SCANT LITTER COVERAGE AND IN THE NATURAL DEPRESSIONS IN THE SOIL SURFACE.

## NATURE OF ACQUIRED SEED DORMANCY

WE LEARNED FROM BIOASSAY EXPERIMENTS OF SAMPLES COLLECTED IN THE FIELD THAT THE ACQUIRED DORMANCY OF DOWNY BROME SEEDS COULD BE BROKEN BY (EVANS AND YOUNG 1975):

1. TIME, EVEN IN DRY STORAGE.
2. ENRICHMENT OF THE GERMINATION SUBSTRATE WITH POTASSIUM NITRATE.
3. ENRICHMENT OF THE SUBSTRATE WITH GIBBERELLIN.

WE USED THIS INFORMATION TO DEVELOP FIELD TECHNIQUES WHERE THE GERMINATION OF DOWNY BROME SEEDS IN THE SEEDBANK COULD BE ENHANCED OR INHIBITED BY MANIPULATING AVAILABLE NITRATE IN THE SEEDBED (YOUNG ET AL. 1997).

## PRACTICAL APPLICATIONS

KNOWLEDGE OF THE SEED AND SEEDBED ECOLOGY OF DOWNY BROME WAS USED TO DEVELOP AND PERFECT HERBICIDAL FALLOW TREATMENTS (ECKERT AND EVANS 1987, ECKERT ET AL. 1974). THE HERBICIDAL FALLOW RESULTED IN THE LOSS OF DOWNY BROME LITTER AND PLACED THE SEEDBED OUTSIDE THE POTENTIAL FOR GERMINATION OF DOWNY BROME. PERENNIAL GRASSES WERE THEN SEEDED USING A DEEP FURROW DRILL WHICH MADE THE SITE DESIRABLE FOR THEIR GERMINATION (EVANS ET AL. 1970) (Figure 5).

## CONCLUSION

THE DOWNY BROME SEED ECOLOGY STORY IS OBVIOUSLY NOT FINISHED. THE BASE THAT HAS BEEN ESTABLISHED PROVIDES A FASCINATING GLIMPSE INTO THE POTENTIAL FOR ENHANCING WEED SUPPRESSION EFFORTS BY UNDERSTANDING THE SEED AND SEEDBED ECOLOGY OF WEED SPECIES.

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