

Recommendation for the release of 9081828 blanketflower selected class germplasm

Scientific Name: *Gaillardia aristata* Pursh (61)

Common Name: blanketflower, common gaillardia, gaillardia, Indian blanketflower, brown-eyed Susan

Germplasm Name: 9081828

Origin: Bulk composite of 15 accessions as shown in appendix table 1.

Description: *Gaillardia aristata* Pursh, blanketflower, is a native, herbaceous perennial in the Aster family. Blanketflower is found in grasslands, woodlands, and montane meadows. It ranges in distribution from southern Canada on both sides of the Rocky Mountains, south to Utah, Colorado, and South Dakota (46). It prefers to grow in the dry, open spaces in prairies, mountain foothills, and along roadsides and railroad rights-of-way (64). Blanketflower is a mid-successional species that may grow in dense populations on disturbed sites (49). It is adapted to a wide range of well-drained soils and is tolerant of drought conditions. Blanketflower is suited to grow well on dry to mesic, well-drained sites in areas receiving 254 to 762 mm (10 to 30 in.) of annual precipitation. Plant growth and development is dependent on site location, with a wide range of dates in emergence and floral initiation. *Gaillardia* was named in honor of Gaillard de Marentonneau, an 18th century French patron of botany (5). The name *aristata* is derived from botanical Latin in reference to the hairy stems and leaves, and the awn-like bristles on the single-seeded fruit (achene). The blanketflower inflorescence is said to resemble the colorful, intricate patterns woven into blankets made by Native Americans (25).

Blanketflower is taprooted, with one or commonly several, erect stems from the base (21). The pubescent plant grows to a height of 67 cm (26 in.) with rough-hairy, lance-shaped, alternate leaves, 15 cm (6 in.) long, 2.5 cm (1 in.) wide, entire to coarsely-toothed, or rarely pinnately divided (51). The flower heads are radiate, showy, solitary or few, and typically composed of 13 sterile, yellow ray flowers with purple bases, 15 to 35 mm (0.6 to 1.4 in.) long (13). The normal flower head of *Gaillardia aristata* has ligulate (strap-shaped) rays. Variation from the normal, however, is common and occurs in the number and form of the rays and in the number of lobes in a ray (44). The tendency to vary is toward a flower-head having a larger number of rays, mixed ligulate and tubular, the latter being four-lobed. A few heads are found with all the rays tubular. The purple, bisexual disk flowers are 7 to 9 mm (0.3 to 0.35 in.) in length, with long hairs at the top (28). The overall appearance of the central disk flowers are said to resemble big, brown eyes, hence the common name, brown-eyed Susan (47). The receptacle is convex to subglobose, with soft or more often chaffy, spine-like bristles which do not subtend the disk flowers (22). The fruit is a one-seeded, gray-brown achene, 3 to 4 mm (0.12 to 0.16 in.) long, with densely ascending hairs, a short pappus crown 7 to 10 mm (0.3 to 0.4 in.) long, and awns approximately two times as long as the fruit body (23). The chromosome numbers for blanketflower is $2n = 34$ (48).

Method of Selection: The accession 9081828 is a composite of 15 accessions that were selected over a testing period of 10 years. The composite consisted of 14 collections from Montana and a single collection from Wyoming, bulked because of their uniformity in flowering, seed maturity, stature, and seedhead abundance. Direct increase of G₀ seed (equivalent to Breeders) constitutes the germplasm.

Performance of Blanketflower 1991-2001

Initial Evaluation Plantings: The initial testing of any new collection usually begins with Initial Evaluation Plantings (IEP) at the Bridger PMC. This involves the establishment of single, direct-seeded, or spaced-planted rows in comparison with other collections of the same or similar species. The long-term average annual precipitation is 287 mm (11.3 in.).

Testing of blanketflower began in the spring of 1991 as part of a larger native wildflower trial that suffered from very poor establishment and was mostly removed in 1992 (54). Three accessions of blanketflower performed well enough to be evaluated the first growing season (table 1). The collections originated from

two counties in Montana: 9058067 and 9058068 (Glacier); and 9058069 (Phillips). The study was conducted under dryland conditions. The annual precipitation in 1991 was 355 mm (13.96 in.), and in 1992 it was 270 mm (10.61 in.).

Table 1. Initial Evaluation Planting. The 1991 performance of *Gaillardia aristata* at the Bridger PMC.

Accession	Vigor [†]	Forage Production [†]	Forage Uniformity [†]	Ground Cover [†]	Seedhead Abundance [†]	Seed Uniformity [†]
9058067	4	5	4	3	5	5
9058068	2	3	2	2	3	3
9058069	2	3	3	2	3	2

[†] Rated 1-9 with 1 best.

A second round of testing began in the spring 1994, as spaced-planted entries of the three previously mentioned accessions and three more from Montana counties: 9058317 (Glacier), 9063363 (Toole), and 9076004 (Garfield). Performance is shown in table 2, with the accession 9076004 from Garfield County rated highest and the remaining collections mostly average in performance (55, 56). The study was also conducted under dryland conditions. The annual precipitation for 1994, 1995, 1996, and 1997 was 270 mm (10.61 in.), 330 mm (12.99 in.), 304 mm (11.98 in.), and 410 mm (16.13 in.), respectively.

Table 2. Initial Evaluation Planting. The 1994-1997 performance of *Gaillardia aristata* at the Bridger PMC.

Accession	Vigor [†]				Vegetative Height cm				Seedhead Abundance		
	1994	1995	1996	1997	1994	1995	1996	1997	1995 [‡]	1996 [†]	1997 [†]
					cm	cm	cm	cm			
9058067	4	6	6	5	5	24	36	21	3	3	5
9058068	4	5	6	5	6	28	32	22	3	3	5
9058069	3	3	3	3	6	30	37	21	4	2	4
9058317	4	3	3	4	7	36	36	19	3	3	4
9063363	5	6	2	2	4	30	26	6	3	5	2
9076004	1	3	2	1	6	33	37	16	3	1	1

[†] Rated 1-9 with 1 best; [‡] Rated 1-4 with 1 best.

A final round of testing began as a dormant field planting in the fall of 1997 with 15 accessions of blanketflower included as part of a larger, miscellaneous forb trial. Included were five of the six previously tested entries from the Montana counties of Garfield, Glacier, Phillips, and Toole (9058317 was excluded); plus eight new collections from the following Montana counties: 9063525 (Stillwater); 9076281 (Madison); 9078282 (Rosebud); 9076247, 9078283, 9078284, 9078285, and 9078444 (Park); and 9078421 (Garfield); and 9078422 from Washakie County, Wyoming. Plot layout allowed cross-pollination.

All of the entries established during the first growing season (table 3). There was an overall increase in plant establishment over the course of the study, despite slight declines in seedhead height and abundance. Time of flowering was fairly consistent and ranged from late May to early June. Seed collected on July 23, 2001, from all the entries was bulked as accession 9081828 (57, 59). The study was conducted under dryland conditions. The annual precipitation for 1998, 1999, 2000, and 2001 was 288 mm (10.94 in.), 201 mm (7.93 in.), 268 mm (10.54 in.), and 235 mm (9.26 in.), respectively.

Other trials: The accession 9081828 was used in five trials from 2002 through 2008 to test the effects of herbicide applications to control broadleaf weeds in seed production fields of native wildflowers. The blanketflower had very good establishment in all of the studies and tolerated some of the chemicals used to control target weeds. Preliminary results indicate effective weed control with the use of pendimethalin and a mix of pendimethalin and trifluralin (65). The research does not recommend use of any tested herbicides not specifically labeled to control broadleaf weeds in wildflower seed production fields. The information will benefit the commercial seed industry.

The testing of this accession has been limited to the Bridger Plant Materials Center in south-central Montana and southwestern Montana near Bozeman.

Table 3. Initial Evaluation Planting. The 1998-2001 performance of *Gaillardia aristata* at the Bridger PMC.

Accession	Vigor [†]				Height cm				Seedhead Abundance [†]		
	1998	1999	2000	2001	1998 [‡] cm	1999 [§] cm	2000 [§] cm	2001 [§] cm	1999	2000	2001
9058067	4	2	1	2	12	50	58	36	3	1	2
9058068	5	2	2	4	11	53	67	40	3	2	4
9058069	4	3	2	5	11	43	40	24	2	2	4
9063363	6	4	3	3	14	35	43	28	4	2	3
9063525	6	2	5	5	12	50	31	30	2	5	5
9076004	3	1	2	5	15	48	42	27	1	2	6
9076247	4	2	3	3	16	57	44	35	2	2	3
9078281	5	3	4	6	14	39	41	30	3	2	5
9078282	6	5	5	5	13	50	48	30	5	4	5
9078283	7	5	2	5	10	40	52	30	5	3	5
9078284	4	4	4	7	15	39	40	30	4	4	5
9078285	5	4	5	6	8	40	41	29	4	6	6
9078421	6	5	3	6	13	35	50	32	5	2	5
9078422	7	6	5	5	15	32	38	35	6	5	5
9078444	5	2	2	5	12	39	43	35	2	2	5

[†] Rated 1-9 with 1 best; [‡] Vegetative height; [§] Seedhead height.

Insect or Disease Problems: Blanketflower has no serious insect or disease problems. Root rot may be a problem in poorly drained soils, especially during extended periods of heavy rain. Powdery mildew may be present at times of elevated humidity, but usually does not have a long-term negative impact on the plants. The species generally is susceptible to aster yellows and fungal leaf spot disease (33). *Gaillardia* is slightly susceptible to oat blue dwarf virus (8).

Ecological and Environmental Considerations: There is an ever-increasing demand for high quality, native forb seed to compete against undesirable weeds and invasive plants, and to facilitate ecological structure and function in restored sites across Canada and the United States (35). The successful establishment of a diverse plant community relies, in part, on the use of adapted plant material that can survive the typically harsh environmental conditions on the site of a reclamation project (34). The extensive distribution, relative abundance, and quick establishment of blanketflower make it a valuable candidate for providing species diversity in seed mixes for the revegetation of disturbed lands (6). Blanketflower lends itself to agronomic seeding methods with acceptable results when planted at the right time and appropriately mixed at the proper seeding rate (37, 67).

As the global demand increases for drinking and irrigation water, there is a concern over the excessive amounts used by introduced plant materials in highly consumptive residential and commercial landscapes (43). Blanketflower is an attractive, showy, native wildflower that is tolerant of drought conditions within its range of adaptation (10). It is recommended for use as an ornamental specimen plant or a mass display in low watering zones of Xeriscape™ and waterwise gardens (26). It may be irrigated using non-potable water with salinity levels up to 5.4 decisiemens per metre with minimal impact to the visual aesthetics of the plant (36). Blanketflower is considered to be a deer-resistant due to the plant's unpalatable and rough-textured stems and leaves (39). The foliage of blanketflower is fire-resistance because of high moisture content, low volatility, and basic chemistry that is less flammable (12). This species is also used in to attract butterflies, moths, songbirds, and a variety of pollinating insects (3). More than 30 hybrid varieties of several species of blanketflower have been developed for use in the floriculture industry with the majority having landscape application in the southern regions of the U.S. (18).

A wide variety of pollinator-friendly and beneficial insects relies on blanketflower as a food source of pollen and nectar, and for resting and cover. It is a common nectar plant for the adult stage of the butterfly, Edwards fritillary *Speyeria edwards* (38). A cryptic moth, *Schinia masoni*, is color-camouflaged to mimic the yellow ray flowers and purplish-brown disk flowers of blanketflower as protection against predators (14). Blanketflower is an indicator plant associated with the upland, dry prairie habitats of the Dakota skipper *Hesperia dacotae* Skinner (9), a butterfly species petitioned as a candidate for listing under the Endangered Species Act (62). In western North America, the widely distributed soft-winged flower beetle *Listrus senilis*, is recognized as a crucial pollinator of blanketflower (32). Several important arthropods are involved in the proper function of northern grassland ecosystems where blanketflower is a component of the plant community (20).

The Indian tribes of North America long recognized the medicinal qualities of blanketflower and used it to treat many ailments (63). The Blackfeet used infusions of roots and leaves to relieve upset stomachs and to treat saddle sores on horses (27). Kiowas picked the flowers for good luck (24). Blanketflower was one of the voucher specimens collected by Captain Meriwether Lewis along the Blackfoot River on July 7, 1806 (40). Cancer studies on major plant groups determined blanketflower contained the sesquiterpene lactone agent, gaillardin, a tumor-killing (antineoplastic) compound (29). There is evidence blanketflower contains substances with antibacterial properties (19). A skin rash or irritation may develop following contact with the juice or sap in the foliage (15).

The tender, young plant growth and insect-rich blooms of blanketflower are a potential food source for young and adult upland game birds, such as sage-grouse and sharp-tail grouse. Forage palatability of blanketflower is rated poor to fair during early stages of growth for domestic livestock. It is a mid-summer maturing species in sagebrush plant communities (41). Blanketflower can be an indicator of range readiness, as it will begin to bloom when more desirable forage plants have reached the stage of growth where they are ready for grazing (68). Blanketflower was a highly selected forb by California bighorn sheep and comprised 2% of late-summer diet (66). It is lightly browsed by white-tailed deer to supplement their diet (4). It has demonstrated a mixed growth response in percentage canopy cover depending on the grazing regime or local site conditions (16). Light grazing by domestic sheep did not noticeably affect the abundance of plants (11). However, the percentage canopy cover of blanketflower more than doubled following a wildfire (2). Species response to grazing and other disturbance factors aid in understanding successional trends in entire plant communities (53). Blanketflower was extremely successful in establishment against competition from Russian knapweed, in part due to the presence of the compound gaillardin (50). Plant communities rich in perennial forb species such as blanketflower, may be more resistant to noxious weed invasion (31). Indigenous, deep-rooted, forb functional groups capture soil moisture and nutrients making them less available for weed establishment (42).

Seed Increase: Experimental seed production of 9081828 at the BPMC yielded approximately 168 kg/ha (150 lb/acre) on an average harvest date of July 29. Seed production is anticipated to be much higher under normal irrigated, agronomic conditions. The accession 9081828 has approximately 486 seeds per gram (220,700 seeds per pound). There are 5 seeds/ft² at 1 lb. pure-live-seed (PLS)/acre; approximately equivalent to a full seeding rate for a 24 in. row spacing of 2.5 lb. PLS/acre (25 seeds/row-foot).

No other conservation release of native blanketflower is available in the northern latitudes to the seed industry. There is a commercial shortage of native forb seed for use in revegetating disturbed areas and re-establishing native plant communities in conservation enhancement and wildlife habitat improvement programs. Currently, the majority of available seed of this species comes primarily from harvest of native sources.

Anticipated Conservation Use: The accession 9081828 was selected primarily for adding species diversity to native plant seed mixes in the rehabilitation of disturbed sites, such as rangelands, minelands, roadsides, park and recreation areas, prairie restoration projects, and conservation plantings in accordance with government farm bill program requirements. Blanketflower is very suitable for use as an ornamental wildflower in low maintenance or natural landscapes such as personal residences, apartment complexes, and private businesses (58). Blanketflower may have application in the production of native

wildflower sod for restoration of natural plant colonies (1). It has utility as a food source for pollinators, wildlife, and livestock.

Anticipated Area of Adaptation: Blanketflower is expected to perform well in areas depicted in Figure 1. It is naturally found from south-central Canada to southern Colorado, east to the Dakotas and west to the Cascade Mountains of Washington and the Blue Mountains of Oregon (30). In Montana, presence of blanketflower has been documented in all 56 counties (7), including nine types of riparian plant communities (17). It is an important component of several habitat types in western Montana (51). Blanketflower is present in the mountain and foothill environments of more than half of the 23 counties in Wyoming (45). It does well on a variety of soil types, including loams to rocky to gravelly-sandy textures; and it tolerates a pH range from slightly acidic to mildly alkaline (60). Blanketflower attains optimum growth in full sun, beginning in early spring until seed set in late summer (52). It occurs at elevations from 400 to 2,743 m (1,300 to 9,000 ft.).

Increase and Distribution: Two generations (G_2 and G_3 equivalent to Certified) beyond G_1 (equivalent to Foundation) are recognized. G_1 seed is available from the USDA-Natural Resources Conservation Service (NRCS) Plant Materials Center (PMC) in Bridger, Montana, through the Foundation Seed Program at Montana State University-Bozeman or the University of Wyoming. G_1 stock will be available in 2011.

Submitted by: This recommendation for the release of 9081828 blanketflower was prepared and submitted by Susan R. Winslow, USDA NRCS, for joint release by the USDA NRCS and the Montana and Wyoming Agricultural Experiment Stations, December 2009.

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Appendix Table 1. *Gaillardia aristata* accession information.

Accession	County	Location	Physical Environment	Date	NRCS Collector
9058067	Glacier, MT	T34N R12W S21	Silty soil, 2% slope, north aspect, 406 mm ppt	8-14-89	Sam Short, Great Falls
9058068	Glacier, MT	T33N R13W S9	Silty soil, 15% slope, west aspect, elev 1,676 m, 508 mm ppt	8-13-89	Sam Short, Great Falls
9058069	Phillips, MT	T32N R29E S26	1% south facing slope, 279 mm ppt	8-22-89	Alan McNeal, Malta
9063363	Toole, MT	T36N R3E S8	Zohill-Zohl loamy soil, 12% slope, south aspect, elev 1,396 m, 381 mm ppt	9-9-91	Matt Crampton, Chinook
9063525	Stillwater, MT	T35N R20E S11	Hilger-Castner soil, cobbly sandy loam texture, 20% slope, east aspect, elev 1,118 m, 254 to 356 mm ppt	7-25-92	Geri Sullivan, Livingston
9076004	Garfield, MT	T20N R33E S5	Kremlin loamy soil, 7% slope, east aspect, elev 1,021 m, 381 to 483 mm ppt	7-28-93	John Monahan, Jordan
9076247	Park, MT	T25N R8E S16	Ridgetop, 2-8% slope, elev 1,585 m, 381 mm ppt	9-17-94	Geri Sullivan, Livingston
9078281	Madison, MT	T3S R1E S30	Oro Fino-Poin Complex soil, gravelly loam texture, 5% slope, east aspect, elev 1,561 m, 254 to 356 mm ppt	8-8-95	Susan R. Winslow & Matt Marsh, Bridger PMC
9078282	Rosebud, MT	T2S R39E S18	42% north slope, 381 to 483 mm ppt	7-28-95	Carla Lawrence, Hal Hunter, Pete Husby, Circle & Bozeman

Appendix Table 1. *Gaillardia aristata* accession information - Continued.

Accession	County	Location	Physical Environment	Date	NRCS Collectors
9078283	Park, MT	T1N R11E S20	Cabba-Regent-Tolman soil, silty clay loam texture, 2% slope, elev 1,573 m, 254 to 356 mm ppt	8-23-95	Robin Fuson & Geri Sullivan, Livingston
9078284	Park, MT	T2S R11E S29	Rocky, loamy-sand soil texture, 35% slope, west aspect, elev 1,665 m, 381 to 483 mm ppt	8-23-95	Robin Fuson & Geri Sullivan, Livingston
9078285	Park, MT	T1N R11E S28	Cabba-Regent-Tolman soil, silty clay loam texture, 20% slope, south aspect, elev 1,615 m, 254 to 356 mm ppt	8-23-95	Geri Sullivan, Livingston
9078421	Garfield, MT	T21N R33E S31	Sabby clay loam soil, 3% slope, north aspect, elev 975 m, 330 mm ppt	8-26-96	John Monahan, Jordan
9078422	Washakie, WY	T42N R86W S27	Boinette loam soil, 8% slope, east aspect, elev 2,469 m, 381 to 483 mm ppt	9-17-96	S. Myers, Worland
9078444	Park, MT	T4N R8E S17	Regent-Wilsall-Tolman soil, clay loam texture, 20% slope, south aspect, elev 1,689 m, 254 to 356 mm ppt	9-12-96	Geri Sullivan, Livingston

Signatures for release of:

9081828 Germplasm Blanketflower *Gaillardia aristata*

Joyce Swartzendruber
State Conservationist
NRCS
Bozeman, Montana

Date

J. Xavier Montoya
State Conservationist
NRCS
Casper, Wyoming

Date

Director
Montana Agricultural Experiment Station
Montana State University
Bozeman, Montana

Date

Director
Wyoming Agricultural Experiment Station
University of Wyoming
Laramie, Wyoming

Date

Director
Ecological Sciences Division
NRCS
Washington, DC

Date

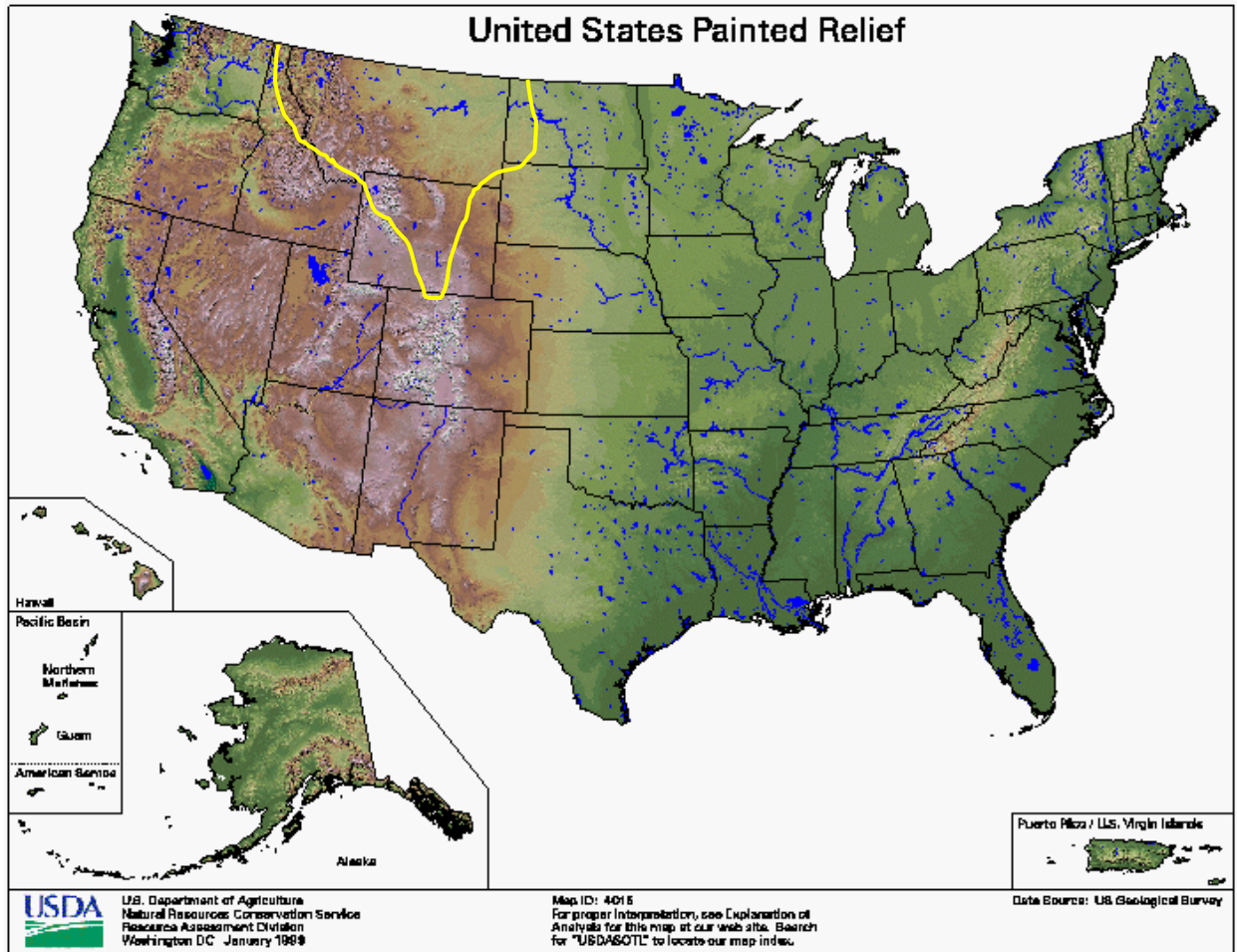


Figure 1. Anticipated area of adaptation of 9081828 blanketflower.