Winter Forage Cover Crop Trials

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Abstract

Several crops were evaluated at Worthy farms, near Marana, AZ, Wakimoto farms, Mohave Valley, near Bullhead City, AZ, and the Tucson Plant Materials Center for use as a winter cover crop following cotton with potential to reduce wind erosion and produce one to two hay cuttings. Hairy vetch (Vicia villosa), 'Lana' woolypod vetch (Vicia villosa ssp. varia), 'Papago' pea (Pisum sativum), and 'Biomaster' pea (Pisum sativum) were sown at the Tucson Plant Materials Center. Species sown at Worthy farm were: Papago pea, Lana vetch, and Biomaster pea. Species sown at Wakimoto farm were: Biomaster pea, Lana vetch, 'Seco' barley (Hordeum vulgare), and 'Multi-cut' berseem clover (Trifolium alexandrinum). Forage yield varied between locations due to sowning date, number of irrigations, and soil textures. Biomaster pea, Papago pea, and Lana vetch performed well at all three locations. However, Biomaster yields were more consistent and due to its shorter growing season may be the better choice as a winter cover between cotton crops. Additional trials are scheduled for the fall of 1998.

Introduction

Soil improvement benefits from leguminous cover crops are well documented. However, traditional southwestern cotton farming practices have not utilized cover crops for a number of reasons including increased production costs and the lack of a productive, high forage quality, short season legume. Blowing dust and potential PM-10 violations are growing concerns in many of the cotton producing areas in Arizona. Mohave Valley experiences its highest wind velocities and lowest rainfall from December to February which coincides with the fallow period between cotton crops. Winter cover crops, which could provide a profitable hay crop, have been suggested as a best management practice to reduce fugitive dust emissions. Also, some growers are becoming interested in growing cotton organically. Cover crops that will supply nitrogen and fit the time available between cotton crops need to be identified and evaluated. The objectives of these trials were to evaluate various winter cover crops for forage production, forage quality as hay for the horse or dairy cows market, and their suitability as a cover crop following cotton.

Seco barley is a water efficient "one irrigation barley" grown for forage, grain, and as a cover crop in south central Arizona. Multi-cut berseem clover has been grown as a fall sown winter hay crop in California deserts and can produce 10-12 tons of high quality hay in 8 cuttings during the period from 1 Dec through July when sown by October. Biomaster pea is a winter forage with high nutritive quality, is well adapted to climates with mild winters, and becomes quickly established. Lana woolypod vetch is commonly grown as a green manure crop and

its spreading, viney growth habit provides a fast ground cover. Hairy vetch is used in the eastern United States as a fall sown green manure crop for summer vegetables.

Materials and Methods

Trials were conducted at the Tucson Plant Materials Center (PMC), Tucson, AZ, Bill Worthy farms, Marana, AZ and Victor Wakimoto farms on the Fort Mohave Indian Reservation near Bullhead City, AZ. The Marana and Fort Mohave Indian Reservation trials were sown following the 1997 cotton crop. Soils at these sites were listed as highly erodible land (HEL). On HEL soils it is desirable to maintain an adequate cover during the winter and spring months to reduce wind erosion.

Traits evaluated included: height, formation of nitrogen fixing nodules, stand, and biomass production. Species planted at the PMC were: hairy vetch , Lana vetch, Papago pea, and Biomaster pea. Species planted at Worthy farms were: Papago pea, Lana vetch, and Biomaster pea. Species planted at the Wakimoto farms were: Biomaster pea, Lana vetch, Seco barley, and Berseem clover. A *Rhizobium* inoculant was added to all species except Seco barley. A sticking agent was used to ensure a good bacteria coating on the seed. Multi-cut berseem clover was pre-inoculated, coated, by the seed vendor.

At the PMC, crops were sown on 03-05 Nov. 1997 in four borders totaling 1.0 acres for each species except hairy vetch which was sown in two borders totaling 0.5 acres. All species were drill seeded at 70-80 lb/A at a depth of 0.5-1.0 inches. One irrigation was applied following planting. Soils are Anthony loamy fine sand and Comoro fine sandy loam. Plantings did not receive supplemental fertilization.

At Worthy farms, crops were sown on 01 Jan 1998. Each species was planted in two-acre blocks at 75-80 lb/A at a depth of 0.5-1.0 inches. Sowing was delayed due to a late cotton harvest and heavy precipitation during Dec. 1997. Soils are Gila sandy loam and Vinton loamy sand. One irrigation was applied after sowing. This trial received subsequent irrigations but these were not recorded. Supplemental fertilizations, if any, were not recorded.

At Wakimoto farms, crops were sown on 25 Dec. 1997 into 6 inch rows. Each forage was planted into one three acre border. Biomaster pea and Seco barley were each sown at 75 lb/A at a depth of 0.5-1.0 inches. Lana vetch was sown at 90 lb/A and 0.5 inches deep. Berseem clover was sown at a rate of 25 lb/A and 0.5 inches deep. Soils are Lagunita sand in the south half of the field and Holtzville silty clay in the north half of the field. Due to differences in production for each soil type, yield and quality measurements were conducted for both soil types. The planting received one irrigation on 02 Jan 1998 with 15 gallons of urea ammonium (UAN32) applied with the irrigation water. Two hundred pounds of ammonium phosphate (16-20-0) was broadcast applied and disced in preplant. Emergence occurred by mid-January for all four crops.

All clipping measurements were conducted with a 9.6 ft^2 frame. Four frames were clipped for each species, border, and soil type. Fresh weight was recorded in grams which allowed for conversion to pounds per acre by multiplying the fresh weight by 10.

Results and Discussion

At the PMC, 100 days after planting (DAP), stand and height measurements were taken (Table 1). Height and fresh weight measurements were made on 14 Apr 1998, 162 DAP, and dry weight measured on 12 May 1998 (Table 1). Hairy vetch did not initiate vigorous growth until late March, allowing a good stand of mustard to establish. Flowering did not begin until 13 April. Nodules were found but they were few and small. Lana vetch had the highest fresh and dry weight yields among all species tested at the PMC. Lana vetch covered the ground and out-competed emerging mustard seedlings. Lana vetch initiated flowering on 15 Mar and finished flowering

the end of April. On 13 Apr, Lana vetch plants had numerous small nodules. These grew well through the spring and matured in mid-May. Papago pea had the second highest fresh weight yield. Plants grew well throughout the season and competed well with mustard especially where the stand was uniform and thick. Papago pea began flowering on 23 Feb and finished flowering on 27 April. Nodules were abundant with many measuring 1/2 inch in diameter. Plants had matured by mid-May. Biomaster pea initiated flowering on 23 Feb. This variety had the largest nodules of all the species with some nodules measuring 1 inch in diameter. Nodules were common in the upper 2-3 inches of the soil but were found as deep as 6 inches. Biomaster pea had the shortest growing season with fruit set by 13 April and matured plants by the end of April.

At Worthy farms on 2 Mar, 46 DAP, stand and height measurements were taken (Table 2). These plots were not clipped until 13 May, 118 DAP. At this time all of the species had matured. Due to warm temperatures in May, the soil's low water holding capacity, and infrequent irrigations, biomass yields were low (Table 2). Plant height measurements were not taken. Biomaster pea performed best in terms of yield, followed by Lana vetch and Papago pea. However, the Biomaster pea was planted close to an existing wheat crop and probably benefited from excess irrigation water. Nodules were found on all species but were smaller and not as numerous as those found at the PMC.

At Wakimoto farms on 19 Feb, 50 DAP, height and stand density was measured (Table 3). Height and yield measurements were taken on 26 Mar, 91 DAP, (Table 4). Forage quality, for all crops, was measured on 11 Mar 1998 for both soil types (Table 5). Only one cutting was possible for the production period going from 25 Dec through 26 Mar for all four forages. Spring forage yields were poor during the short production period for berseem clover sown on either soil and Biomaster pea sown on the silty clay soil. Highest forage yields resulted from sowing Biomaster pea or Lana vetch on the sandy soil and Seco barley or Multi-cut berseem clover on the silty clay soil (Table 4). Multi-cut berseem clover was slow growing and produced low tonnage and relatively lower quality hay, compared to the other forage crops. This was due to the late planting date which resulted in very slow establishment. Lana vetch produced ample tonnage and good quality hay but due to its low, spreading, growth habit it was too short to cut for hay with a mechanical harvester or swather. However, it provided a fast ground cover and would make an excellent green manure crop with its relatively high tonnage and very high nitrogen content. Seco barley was also a fast growing ground cover and produced high tonnage compared to the other forages. However, it had a relatively poor hay quality. Grown under the conditions of this study, it would be a good choice for a residue/ erosion control crop. Biomaster pea had relatively high hay tonnage, high protein levels, and low acid detergent fiber levels, compared to the other forages grown in this study. It was not harvested mechanically for hay, but seemed to cure well enough to put up an acceptable bale. Nodules were found on the all of the legumes with Biomaster pea having the largest at approximately 1/4 inch in diameter.

In summary, Biomaster pea, Lana vetch, and Papago pea have potential as winter cover crops. Biomaster pea, due to its shorter growing season, may be the best suited variety. Forage yield potentials for the above crops will be reevaluated during 1998-99.

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Table 1. Winter Cover Crops at the Tucson Plant Materials Center

Forage	Stand (plts/ft^2) (100 DAP) 11 Feb 1998	Height (in) (100 DAP) 11 Feb 1998	Height (in) (162 DAP) 13 Apr 1998	Fresh Weight (lb/A) (162 DAP)	Dry Weight (lb/A)
Hairy vetch	6.8	1.5	17.7	14,147	2,155
Papago pea	7.0	11.9	29.1	26,649	5,602
Biomaster pea	9.6	10.9	17.4	20,089	4,327
Lana vetch	4.4	5.0	21.9	34,984	7,303

Table 2. Winter Cover Crops at Bill Worthy Farms

Forage	Stand (plts/ft^2) (46 DAP) 2 Mar 1998	Height (in) (46 DAP) 2 Mar 1998	Fresh Weight (lb/A) (118 DAP)	Dry Weight (lb/A)
Biomaster pea	1.9	4.6	8,125	3,275
Papago pea	2.4	2.3	1,875	1,275
Lana vetch	6.5	3.0	6,625	3,375

Table 3. Winter Cover Crops at Victor Wakimoto Farms measure 11 Mar 1998 (76 DAP)

Forage	Soil Type	Ground Cover (%)	Plants / ft^2	Height (in)	Width (in)	Dry Weight (lb/A)
Biomaster pea	sand	54	4.4	13.6	8.8	752
	silty clay	55	6.6	10.4	6.0	618
Lana vetch	sand	73	7.7	0.8	7.4	360
	silty clay	51	6.8	0.8	6.8	205
Seco barley	sand	65	13.4	10.4	6.0	794
	silty clay	90	10.3	16.8	7.2	2108
Multi-cut berseem clover	sand	65	30.6	2.8	3.2	351
	silty clay	67	25.2	2.8	3.4	329

Table 4. Winter Cover Crops at Victor Wakimoto Farms

Forage	Soil Type	Height (in) (50 DAP) 19 Feb 1998	Height (in) (91 DAP) 26 Mar 1998	Fresh Weight (lb/A) (91 DAP)	Dry Weight (lb/A)
Biomaster pea	sand	6.0	18.0	4,750	3,119
	silty clay	4.5	15.0	2,940	1,701
Lana vetch	sand	2.5	6.0	4,310	3,686
	silty clay	2.5	5.0	3,560	2,552
Seco barley	sand	7.0	16.0	2,840	2,835
	silty clay	7.0	32.0	8,940	7,860
Multi-cut berseem clover	sand	1.0	4.0	1,030	659
	silty clay	1.0	6.0	3,050	1,701

Table 5. Winter Cover Crops Victor Wakimoto Farms: Forage Quality Analysis

Forage	Neutral Detergent Fiber (%)	Acid Detergent Fiber %)	Crude Fiber (%)	Crude Protein (%)	Nitrogen (%)
Biomaster pea	27.8	23.3	18.4	23.6	3.8
Lana vetch	26.6	21.1	16.7	30.3	4.8
Seco barley	41.7	25.4	20.0	15.6	2.5
Multi-cut berseem clover	31.5	19.4	15.4	19.2	3.1