**Table 1.** Means for forage biomass (FB) and nutritional composition of alternative forage crops during the 2015 spring season (only one harvesting schedule)

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable**  | **Alternative forage crops**  | **SEM** | ***P*-value** |
| **Wheat** | **Triticale** | **Barley** | **Cereal rye** | **Hairy vetch** |
| FB, kg/ha | 1005.1a | 978.5a | 31.6b | 740.0ab | 345.6ab | 179.2 |  0.0091 |
| CP, % | 18.0c | 15.3c | 28.3b | 16.8c | 35.3a | 1.31 | < 0.0001 |
| SP, % CP | 44.0a | 44.2a | 45.4a | 44.0a | 40.7b | 0.72 |  0.0101 |
| ADF, % | 30.4a | 28.7a | 23.7b | 27.2ab | 28.2ab | 1.02 |  0.0144 |
| NDF, % | 51.6a | 48.0a | 36.7b | 48.5a | 35.7b | 1.27 | < 0.0001 |
| Lignin, % | 2.27b | 2.12b | 2.49b | 2.12b | 6.95a | 0.56 |  0.0002 |
| NFC, % | 16.8ab | 24.3a | 21.8ab | 21.3a | 11.8b | 2.16 |  0.0109 |
| EE, % | 3.75bc | 3.42c | 6.46a | 4.17bc | 4.60b | 0.24 |  0.0012 |
| TDN, % | 70.7b | 72.2ab | 74.4a | 73.2ab | 66.2c | 0.72 | < 0.0001 |
| Ash, % | 9.78b | 8.96b | 10.7b | 9.04b | 13.1a | 0.35 | < 0.0001 |

CP = crude protein; SP = soluble protein; ADF = acid detergent fiber; aNDF = neutral detergent fiber; NFC = nonfiber carbohydrate [100% - (CP% + NDF% + Fat% + Ash%)]; EE = ether extract; TDN = total digestible nutrients; SEM = standard error of the mean

a-c Means followed by different letters in the same row differ at 5% significance by the Tukey test.

**Table 2.** Means for forage biomass production, and nutritional composition of annual forage crops under three harvestings schedule during the summer 2015

|  |  |  |  |
| --- | --- | --- | --- |
| **Harvest1** | **Annual forage crops** | **SEM2** | ***P*- value** |
| **BMR Sorghum** | **Buckwheat** | **Teff** | **Millet** | **Oats** | **Chickling Vetch** |
|  | **Forage biomass Kg/ha** |  |
| 123 | 446.1Bbc1,065ABcd1,723Ab | 1,857Ba3,335Aa4,148Aa | 208.5Bbc610.1Ad972.8Abc | 1,034Cabc2,104Bbc3,307Aa | 1250.5Bab2673.1Aab3493.3Aa | 89.5Bc269.2Ad339.8Ac | 216.2 | < 0.0001 |
|  | **Crude protein (%)** |  |
| 123 | 18.3Abc10.7Bb8.65Bb | 12.1Ac9.17Ab8.30Ab | 19.8Aab12.7Bb9.85Bb | 14.4Abc9.27Ab7.60Bb | 16.4Abc10.6ABb8.22Bb | 26.1Aa29.0Aa28.3Aa | 1.39 | 0.0019 |
|  | **Lignin (%)** |  |
| 123 | 3.22Ab2.05Abc2.37Ab | 10.0Aa9.40Aa11.62Aa | 2.65Ab1.80Ac3.22Ab | 2.42Ab2.42Abc3.27Ab | 2.30Ab3.17Abc4.00Ab | 4.02Bb4.72Bb9.30Aa | 0.512 | 0.0003 |
|  | **Non-fiber carbohydrates (%)** |  |
| 123 | 11.5Ab20.0Ab16.9Ab | 28.7Aa30.8Aa31.2Aa | 10.2Ab12.2Ac17.9Aab | 13.5Ab16.0Abc15.7Ab | 20.4Aab17.6Ab19.1Aab | 28.2Aa28.3Aa20.9Aab | 1.95 | 0.0016 |
|  | **Ash (%)** |  |
| 123 | 12.0Aa8.93Ba8.68Ba | 11.0Aa8.51ABa7.61Ba | 8.87Aa8.89Aa7.49Aa | 11.5Aa10.11Aa9.41Aa | 11.1Aa9.08ABa6.94Ba | 9.31Aa9.45Aa9.23Aa | 0.615 | 0.0296 |

1Harvest 1 = 07/16/2015; Harvest 2 = 07/23/2015; Harvest 3 = 07/30/2015; 2SEM = standard error of the mean.

A-C a-d Means with different uppercase letters within a column and lowercase letters within a row differ at 5% significance by the Tukey test.

**Table 3.** Means for forage biomass production, and nutritional composition of annual forage crops under three harvestings schedule during the fall 2015

|  |  |  |  |
| --- | --- | --- | --- |
| **Harvest1** | **Alternative forage crops** | **SEM2** | ***P*- value** |
| **Forage Radish** | **Oats** | **Canola** | **Wheat** | **Triticale** | **Sunn hemp** |
|  | **Forage biomass** |  |
| 123 | 1,688A1,898Abc1,851Abc | 1,393B2,643Aab3,152Aa | 1,7292,218abc2,064ab | 1,5963,234a3,076a | 862.42,115abc2417.5ab | 1031.31280.8c694.4c | 230.1 | < 0.0001 |
|  | **Crude protein (%)** |  |  |
| 123 | 15.5Ab12.0Ba13.2ABab | 17.5Ab12.7Ba8.60Cc | 18.8Aab12.0Ba12.8Bab | 18.2Ab10.8Ba9.50Bc | 21.5Aa13.4Ba10.3Cbc | 16.6Ab11.6Ba13.6Ba | 0.59 | < 0.0001 |
|  | **Acid detergent fiber (%)** |
| 123 | 19.6Ac20.3Ab21.9Ab | 29.9Aa31.8Aa28.2Aab | 20.7Abc18.3ABb12.5Bc | 30.6Aa35.8Aa33.7Aa | 28.2Aa31.7Aa31.8Aa | 28.1Aab32.8Aa35.2Aa | 1.42 | 0.0015 |
|  | **Neutral detergent fiber (%)** |  |  |
| 123 | 21.8Bc23.7ABd26.6Ac | 48.6Aa48.0Ab44.8Ab | 22.2Ac23.0Ad18.8Ad | 54.4Aa58.1Aa55.7Aa | 50.8Aa53.3Aab51.4Aab | 34.2Bb38.3Bc48.6Aab | 1.46 | < 0.0001 |
|  | **Non-fiber carbohydrates (%)** |  |  |
| 123 | 40.9ABa43.5Aab38.7Bb | 16.1Bb25.0Bc36.8Ab | 37.0Ba49.8Aa53.1Aa | 13.2Bb21.2ABc26.5Ac | 11.4Bb21.3Ac28.8Abc | 36.7ABa40.1Ab31.1Bbc | 1.69 | < 0.0001 |
|  | **Ash (%)** |  |  |
| 123 | 17.5Aa17.4Aa18.3Aa | 12.9Ab10.7Bb7.52Cc | 13.3Ab10.8Bb10.5Bb | 9.82Acd7.33Bc6.16Bcd | 11.4Abc8.93Bbc6.83Ccd | 9.05Ad7.73Ac5.13Bd | 0.42 | < 0.0001 |

1Harvest 1 = 10/02/2015; harvest 2 = 10/19/2015; harvest 3 = 11/04/2015; 2SEM = standard error of the mean

A-C a-dMeans with different uppercase letters within a column and lowercase letters within a row differ at 5% significance by the Tukey test