Nutrient Removal Values - Phosphorus

	Projected phosphorus removal (as P_2O_5), "wet" or "as is" basis				% Moisture, Dry matter			Number of samples in survey *
					Median*		Survey range*	
	lb P_2O_5 per yield unit	*	Survey range*		- moisture -	--------- dry matter ---------		
Grains, oilseeds, fiber, sugar crops								
Barley, grain	**0.35** / bu *(48 lb)*	1	0.32 - 0.40		11.1	*88.9*	*87.2 - 90.0*	*197*
Beans *(dry)*	**0.62** / cwt *(100 lb)*	2	---		10.0	*90.0*	---	---
Beans *(navy)*	**1.24** / cwt *(100 lb)*	3	---		10.0	*90.0*	---	---
Buckwheat, grain	**0.38** / bu *(52 lb)*	2	---		12.0	*88.0*	---	---
Canola, grain	**0.86** / bu *(60 lb)*	4	---		8.0	*92.0*	---	---
Corn, grain *(dry shelled)*	**0.31** / bu *(56 lb)*	1	0.28 - 0.33		14.2	*85.9*	*84.9 - 86.7*	*4,032*
	0.55 / cwt *(100 lb)*	1	0.51 - 0.59		14.2	*85.9*	*84.9 - 86.7*	*4,032*
Corn, grain *(high moisture)*	**0.26** / bu *(56 lb)*	2	0.24 --- 0.28		29.7	*70.3*	*67.4 - 72.9*	*4,820*
	0.46 / cwt *(100 lb)*	2	0.43 --- 0.50		29.7	*70.3*	*67.4 - 72.9*	*4,820*
Cotton *(seed, lint, trash)* *(≈1300 lb seed cotton yields 480 lb lint)*	**11.2** / 1300 lb *(bale)*	3	---		---	---	---	---
Cotton seeds	**1.33** / cwt *(100 lb)*	2	---		8.0	*92.0*	---	---
Field pea, seeds	**0.56** / bu *(60 lb)*	2	---		11.5	*88.5*	---	---
Flax, grain	**0.84** / bu *(56 lb)*	5	---		8.7	*91.3*	---	---
Millet grain	**0.36** / bu *(50 lb)*	2	---		13.0	*87.0*	---	---
Oats, grain	**0.23** / bu *(32 lb)*	1	0.22 - 0.27		11.0	*89.0*	*87.8 - 90.6*	*91*
Peanuts, whole	**0.55** / cwt	6	---		10.0	*90.0*	---	---
Popcorn	**0.38** / bu *(56 lb)*	3	---		10.1	*89.9*	---	---
Potato tuber, fresh	**0.13** / cwt *(100 lb)*	3	---		77.0	*23.0*	---	---
Rice, grain	**0.29** / bu *(45 lb)*	2	---		11.0	*89.0*	---	---
Rye, grain	**0.62** / bu *(56 lb)*	2	---		11.0	*89.0*	---	---
Safflower seeds	**0.55** / bu *(38 lb)*	4	---		8.0	*92.0*	---	---
Sorghum, grain *(milo)*	**0.32** / bu *(56 lb)*	1	0.30 - 0.36		13.0	*87.0*	*85.8 - 88.2*	*820*
	0.58 / cwt *(100 lb)*	1	0.54 - 0.63		13.0	*87.0*	*85.8 - 88.2*	*820*
Sorghum, grain *(high moisture)*	**0.28** / bu *(56 lb)*	1	0.24 - 0.29		30.5	*69.5*	*65.2 - 74.5*	*97*
	0.49 / cwt *(100 lb)*	1	0.43 - 0.52		30.5	*69.5*	*65.2 - 74.5*	*97*
Soybeans, whole	**0.78** / bu *(60 lb)*	4	---		12.0	*88.0*	---	---
Spelt, grain	**0.32** / bu *(40 lb)*	2	---		12.0	*88.0*	---	---
Sugarbeet ***(root)***	**2.19** / ton	3	---		80.0	*20.0*	---	---
Sugarcane	**1.20** / ton	7	---		74.0	*26.0*	---	---
Sunflower seeds	**1.37** / cwt *(100 lb)*	4	---		9.8	*90.3*	---	---
Triticale, grain	**0.47** / bu *(60 lb)*	2	---		11.0	*89.0*	---	---
Wheat, grain	**0.46** / bu *(60 lb)*	1	0.42 - 0.51		11.3	*88.7*	*87.5 - 89.9*	*355*
Hay, legumes								
Alfalfa hay	**10.0** / ton	1	8.4 - 11.1		12.7	*87.3*	*85.0 - 89.1*	*8,360*
Clover, hay alsike clover	**9.7** / ton	2	---		12.6	*87.4*	---	---
Clover hay, ladino clover	**13.1** / ton	2	---		10.0	*90.0*	---	---

"Phosphorus" is expressed in terms of fertilizer equivalent phosphate as "P_2O_5", where P x 2.28 = P_2O_5.

To estimate the equivalent hay or silage yield based on grain yield or hay yield based on stocking rates as animal units, see Crop File 1.02.022, Yield Goal Equivalents: Silage, Hay, and Pasture

	Projected phosphorus removal (as P_2O_5), "wet" or "as is" basis			% Moisture, Dry matter			Number of samples in survey *
				Median*		Survey range*	
	lb P_2O_5 per yield unit *		Survey range*	- moisture -	--------- dry matter ---------		
Hay, legumes *(continued)*							
Clover hay, red clover	**10.0** / ton	2	---	12.0	*88.0*	---	---
Clover hay, sweetclover	**10.4** / ton	2	---	9.0	*91.0*	---	---
Cowpea hay	**12.5** / ton	2	---	9.6	*90.4*	---	---
Lespedeza hay	**9.2** / ton	6	---	8.0	*92.0*	---	---
Peanut hay	**3.7** / ton	1	3.3 - 4.9	10.8	*89.2*	*86.4 - 90.8*	*56*
Sanfoin hay	n/a		---	---	---	---	---
Soybean hay	**6.7** / ton	1	4.4 - 8.0	13.0	*87.1*	*83.2 - 90.4*	*76*
Trefoil hay, birdsfoot trefoil	**9.7** / ton	2	---	11.0	*89.0*	---	---
Vetch hay	**13.8** / ton	2	---	11.0	*89.0*	---	---
Hay, grasses							
Bahiagrass	**8.2** / ton	2	---	10.0	*90.0*	---	---
Bermudagrass hay	**8.6** / ton	1	7.0 - 10.3	10.0	*90.0*	*87.4 - 91.8*	*350*
Bluegrass hay	**10.7** / ton	7	---	11.0	*89.1*	---	---
Bluestem hay	**5.1** / ton	3	---	9.9	*90.1*	---	---
Bromegrass hay	**7.2** / ton	1	5.6 - 8.4	11.8	*88.2*	*86.3 - 89.9*	*241*
CRP hay	**4.4** / ton	1	-	11.4	*88.6*	*85.7 - 90.6*	---
Fescue hay	**10.4** / ton	2	---	12.2	*87.8*	---	---
Meadow hay	**7.3** / ton	1	6.1 - 8.6	10.6	*89.4*	*87.0 - 90.9*	*215*
Mixed grass hay	**7.1** / ton	1	4.9 - 8.6	10.7	*89.3*	*86.5 - 91.8*	*2,951*
Native grass hay	**4.4** / ton	1	3.2 - 6.4	12.9	*87.1*	*67.5 - 90.5*	*227*
Orchardgrass hay	**12.0** / ton	2	---	12.0	*88.0*	---	---
Prairie hay	**4.8** / ton	2	3.6 --- 6.1	11.4	*88.6*	*86.6 - 90.2*	*295*
Reed canarygrass hay	**10.4** / ton	2	---	9.0	*91.0*	---	---
Ryegrass hay	**12.3** / ton	2	---	8.5	*91.5*	---	---
Switchgrass hay	**5.9** / ton	3	---	4.6	*95.4*	---	---
Teff hay	n/a		---	---	---	---	---
Timothy hay	**8.0** / ton	2	---	12.0	*88.0*	---	---
Wheatgrass hay	**8.4** / ton	2	---	11.7	*88.4*	---	---
Hay, small grains							
Barley hay	**9.5** / ton	1	7.9 - 11.1	13.2	*86.8*	*84.1 - 88.7*	*757*
Millet hay	**7.5** / ton	1	5.9 - 9.5	13.1	*86.9*	*83.3 - 89.4*	*399*
Oat hay	**9.6** / ton	1	8.4 - 11.2	12.1	*87.9*	*84.9 - 90.1*	*919*
Rye hay	**10.8** / ton	1	8.2 - 12.8	12.4	*87.6*	*84.6 - 90.2*	*71*
Triticale hay	**9.8** / ton	1	8.2 - 11.8	10.4	*89.6*	*86.0 - 92.0*	*204*
Wheat hay	**8.9** / ton	1	6.9 - 10.9	11.5	*88.5*	*84.9 - 90.7*	*684*
Hay, annual sorghums							
Canex hay	n/a		---	---	---	---	---
Forage sorghum hay	**6.1** / ton	1	5.0 - 8.0	16.1	*83.9*	*76.6 - 90.0*	*101*
Haygrazer hay	**6.4** / ton	1	5.1 - 8.7	17.2	*82.8*	*54.6 - 88.9*	*139*
Milo (grain sorghum) hay	**5.8** / ton	1	4.0 - 7.2	21.0	*79.0*	*61.3 - 85.9*	*128*
Sorghum hay	**6.4** / ton	1	5.3 - 8.3	17.1	*82.9*	*74.7 - 87.5*	*294*
Sorghum-sudan hay	**6.9** / ton	1	5.7 - 8.8	16.3	*83.7*	*74.7 - 88.0*	*156*
Sudan hay	**6.5** / ton	1	5.4 - 8.8	16.2	*83.8*	*77.3 - 87.8*	*370*
Sumac hay	n/a		---	---	---	---	---

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To estimate the equivalent hay or silage yield based on grain yield or hay yield based on stocking rates as animal units, see Crop File 1.02.022, Yield Goal Equivalents: Silage, Hay, and Pasture

	Projected phosphorus removal (as P_2O_5), "wet" or "as is" basis			% Moisture, Dry matter			Number of samples in survey *
				Median*	Survey range*		
	lb P_2O_5 per yield unit *		Survey range*	- moisture -	--------- dry matter ---------		
Hay, miscellaneous							
Cane hay	**6.4** / ton	1	4.9 - 7.9	17.0	*83.0*	*77.4 - 86.8*	*610*
Corn hay	**6.6** / ton	1	3.5 - 8.3	14.3	*85.7*	*77.9 - 89.7*	*108*
Kochia hay	**8.2** / ton	2	---	12.6	*87.4*	---	---
Weed hay	**8.6** / ton	1	6.5 - 10.7	12.2	*87.9*	*84.4 - 90.3*	*58*
Silage, annual crops							
Barley silage	**4.5** / ton	1	3.8 - 5.1	66.3	*33.7*	*30.8 - 38.3*	*387*
Cane silage	**2.3** / ton	1	2.1 - 2.6	71.4	*28.6*	*24.9 - 33.3*	*231*
Corn silage	**3.4** / ton	1	2.9 - 3.8	66.3	*33.7*	*30.2 - 37.8*	*9,910*
Corn silage (sweet corn)	n/a		---	---	---	---	---
Forage sorghum silage	**2.4** / ton	3	---	70.2	*29.8*	---	---
Milo silage (grain sorghum)	**3.8** / ton	1	3.1 - 4.2	64.9	*35.1*	*28.9 - 41.4*	*103*
Oat silage	**4.2** / ton	1	3.7 - 5.1	64.8	*35.3*	*29.1 - 42.8*	*115*
Oatlage	**4.1** / ton	1	3.5 - 4.9	66.3	*33.7*	*28.9 - 43.0*	*145*
Rye silage	**4.5** / ton	1	3.8 - 5.7	68.9	*31.1*	*26.0 - 38.6*	*214*
Small grain silage	**4.3** / ton	1	3.8 - 4.8	65.1	*34.9*	*30.7 - 38.7*	*597*
Sorghum silage	**2.6** / ton	1	2.2 - 3.1	70.5	*29.5*	*26.2 - 33.1*	*1,750*
Sorghum-sudan silage	**2.2** / ton	1	---	68.5	*31.5*	---	---
Sudangrass silage	**3.2** / ton	3	2.3 - 3.8	71.0	*29.1*	*24.5 - 36.3*	*71*
Triticale silage	**4.3** / ton	1	3.7 - 5.1	67.3	*32.7*	*28.1 - 38.8*	*346*
Wheatlage	**4.1** / ton	1	3.6 - 4.8	63.9	*36.1*	*31.5 - 41.7*	*881*
Wheat silage	**4.2** / ton	1	3.6 - 4.9	65.5	*34.5*	*30.3 - 39.9*	*410*
Silage, perennial crops							
Alfalfa haylage	**5.4** / ton	1	4.7 - 6.2	59.1	*40.9*	*34.1 - 48.1*	*752*
Alfalfa silage	**4.4** / ton	1	3.9 - 5.3	64.0	*36.0*	*31.3 - 43.2*	*168*
Bermudagrass silage	**2.4** / ton	2	---	74.0	*26.0*	---	---
Bromegrass silage	**4.8** / ton	2	---	65.0	*35.0*	---	---
Mixed grass silage	**3.3** / ton	2	---	70.0	*30.0*	---	---
Ryegrass silage	**5.5** / ton	2	---	68.0	*32.0*	---	---
Timothy silage	**4.2** / ton	2	---	66.0	*34.0*	---	---
Crop residues							
Barley straw	**3.3** / ton	3	---	10.0	*90.0*	---	---
(72 lb straw/bu)	**0.12** / bu harvested	3	---	---	---	---	---
Buckwheat straw	**4.1** / ton	3	---	11.3	*88.7*	---	---
Canola straw *(236 lb straw/cwt)*	n/a		---	---	---	---	---
Corn cobs	**1.6** / ton	2	---	6.4	*93.6*	---	---
Corn stalks	**3.5** / ton	1	2.7 - 4.7	15.0	*85.0*	*79.9 - 88.1*	*132*
Corn stover	**4.9** / ton	1	3.2 - 6.9	11.3	*88.7*	*83.3 - 92.1*	*100*
(70 lb stover/bu)	**0.14** / bu harvested	3	---	---	---	---	---
Cotton stover *(1300 lb seed cotton yields 480 lb lint)*	**6.7** / bale	2	---	7.7	*92.3*	---	---
Flax straw *(80 lb straw/bu)*	**0.14** / bu harvested	3	---	7.7	*93.0*	---	---
Grain sorghum (milo) stalks	n/a		---	---	---	---	---
Millet straw	**4.3** / ton	2	---	10.0	*90.0*	---	---
(84 lb straw/bu)	**0.18** / bu harvested	3	---	---	---	---	---

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	Projected phosphorus removal (as P_2O_5), "wet" or "as is" basis			% Moisture, Dry matter			Number of samples in survey *
				Median*	Survey range*		
	lb P_2O_5 per yield unit *		Survey range*	- moisture -	--------- dry matter ---------		
Crop residues							
Oat straw	**2.9**	/ ton [2]	---	9.0	*90.3*	---	---
(44 lb straw/bu)	**0.06**	/ bu harvested [3]	---	---	---	---	---
Peanut stover	**6.8**	/ ton [2]	---	---	---	---	---
Popcorn stover	**30.8**	/ ton [3]	---	12.7	*87.3*	---	---
(56 lb stover/bu)	**0.86**	/ bu harvested [3]	---	---	---	---	---
Potato vines	**2.0**	/ ton [2]	---	85.0	*15.0*	---	---
Rice straw	**3.3**	/ ton [3]	---	9.2	*90.8*	---	---
(100 lb straw/cwt)	**0.17**	/ cwt harvested [3]	---	---	---	---	---
Rye straw	**3.0**	/ ton [7]	---	9.1	*90.9*	---	---
(87 lb straw/bu)	**0.17**	/ bu harvested [3]	---	---	---	---	---
Sorghum stover	**4.8**	/ ton [2]	---	8.1	*91.9*	---	---
(56 lb stover/bu)	**0.16**	/ bu harvested [3]	---	---	---	---	---
Soybean stover	**1.1**	/ ton [2]	---	13.9	*86.2*	*83.1 88.2*	*69*
(96 lb stover/bu)	**0.11**	/ bu harvested [3]	---	---	---	---	---
Sugarbeet top	**1.9**	/ ton [2]	---	81.0	*19.0*	---	---
Sunflower stover	**2.0**	/ ton [7]	---	13.3	*86.7*	---	---
(150 lb stover/cwt)	**0.24**	/ cwt harvested [3]	---	---	---	---	---
Wheat straw	**2.9**	/ ton [1]	2.5 - 4.9	9.8	*90.3*	*86.5 94.0*	*187*
(92 lb straw/bu)	**0.13**	/ bu harvested [3]	---	---		---	---
Fresh forage, vegetative stage - annuals							
Cane plants, fresh	**2.3**	/ ton [3]	---	73.7	*26.4*	---	---
Corn plants, fresh	**2.6**	/ ton [1]	2.3 - 3.2	74.0	*26.1*	*21.3 - 33.8*	*121*
Forage sorghum plants, fresh	**2.3**	/ ton [1]	---	71.5	*28.5*	---	---
Millet plants, fresh	**3.4**	/ ton [3]	2.6 - 4.1	70.0	*30.1*	*22.2 - 40.2*	*56*
Milo plants, fresh *(grain sorghum)*	**2.5**	/ ton [3]	---	66.6	*33.4*	---	---
Oat plants, fresh	**4.0**	/ ton [3]	---	70.4	*29.6*	---	---
Rye plants, fresh	**3.5**	/ ton [3]	---	68.9	*31.2*	---	---
Sorghum plants, fresh	**2.6**	/ ton [1]	1.9 - 3.6	71.9	*28.1*	*23.3 - 34.1*	*112*
Sorghum-sudan plants, fresh	**2.3**	/ ton [3]	---	72.4	*27.6*	---	---
Sudangrass plants, fresh	**3.0**	/ ton [2]	---	75.1	*24.9*	---	---
Triticale plants, fresh	**4.4**	/ ton [3]	---	68.0	*32.0*	---	---
Weeds, fresh	n/a		---	---	---	---	---
Wheat plants, fresh	**4.4**	/ ton [1]	3.5 - 5.4	63.2	*36.9*	*27.5 - 47.3*	*92*
Fresh forage, vegetative stage - perennial grasses							
Bermudagrass, fresh	**2.6**	/ ton [3]	---	71.0	*29.0*	---	---
Bluestem, fresh	**3.3**	/ ton [2]	---	39.0	*61.0*	---	---
Bromegrass, fresh	**4.7**	/ ton [2]	---	70.0	*30.0*	---	---
Fescue, fresh	**4.9**	/ ton [2]	---	71.0	*29.0*	---	---
Mixed grass, fresh	**3.9**	/ ton [1]	1.9 - 5.1	30.5	*69.6*	*46.2 - 86.9*	*2,870*
Native grass, fresh	**3.4**	/ ton [1]	2.3 - 4.5	58.5	*41.6*	*33.5 - 52.1*	*149*
Orchardgrass, fresh	**4.3**	/ ton [2]	---	76.0	*24.0*	---	---
Timothy, fresh	**3.3**	/ ton [2]	---	74.0	*26.0*	---	---
Wheatgrass (crested), fresh	**5.4**	/ ton [2]	---	63.0	*37.0*	---	---

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	Projected phosphorus removal (as P_2O_5), "wet" or "as is" basis		% Moisture, Dry matter			Number of samples in survey *
			Median*		Survey range*	
	lb P_2O_5 per yield unit *	Survey range*	- moisture -	--------- dry matter ---------		
Fresh forage, vegetative stage - legumes						
Alfalfa, fresh	**4.3** / ton [1]	3.8 - 4.9	72.4	*27.6*	*20.8 - 39.5*	*63*
Clover (ladino), fresh	**3.3** / ton [2]	---	81.0	*19.0*	---	---
Clover (red), fresh	**3.3** / ton [2]	---	76.0	*24.0*	---	---
Lespedeza, fresh	**2.7** / ton [2]	---	75.0	*25.0*	---	---
Trefoil (birdsfoot) fresh	**2.5** / ton [2]	---	78.0	*22.0*	---	---

Removal by animal type[8,9]

Beef cattle	0.0051 lb P_2O_5 per pound of weight gain *(based on average 20% protein in meat, bones, offal, etc.)*
Poultry	0.0257 lb P_2O_5 per 5 lb market-weight broiler
Dairy cows	0.00217 lb P_2O_5 per cwt (100 lb) of milk

"Phosphorus" is expressed in terms of fertilizer equivalent phosphate as "P_2O_5", where P x 2.28 = P_2O_5.

(Crop residue weights per unit of yield harvested were derived from NRCS PLANTS database.)

* References and Resources

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4 Walker, J. 2007. Oilseed Crops in Beef Cattle Rations. Extension Extra 2058. South Dakota State Univ. Coop. Ext. Serv., Brookings SD. *(http://pubstorage.sdstate.edu/agbio_publications/articles/exex2058.pdf, 25 June 2014)*

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