

**Report about winterpea-wintertriticale-mixture-tests in
combination of three triticale-types with ten pea-types in season
2018/19 (first year of trial)**

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Abstract

Five combinations of isogenic winter peas (normal leaf type : semileafless) with different length (10 samples) were combined with three different triticale varieties. Because of loss of peas during season and their low contribution to harvest, the expressiveness of the trial is low. But statistical analyses on yield showed differences between triticale varieties depending on pea varieties and pea varieties independent from triticale varieties, but no statistical interactions. Short peas were suppressed most, but a medium type in length could reach nearly up to the very tall pea varieties, which suppressed triticale most. For the medium length type of pea the triticale seemed to be a more or less strong competitor. The trial will be repeated in season 2019/20.

Location(s)

53°12'49.3"N, 10°50'29.2"E , DE-21371 Tosterglope-Koehlingen-BusStop, loamy sand

List of accessions

In 2018/19

Winterpeas (seed density 70 seeds/m²) all with white flowers

<i>DZP 11 03 b V</i>	<i>short (3), normal leaf</i>
<i>DZP 11 01 e R</i>	<i>short (3), semileafless</i>
<i>DZP 10 09 d4 V</i>	<i>short to medium (4), normal leaf</i>
<i>DZP 10 09 e1 R</i>	<i>short to medium (4), semileafless</i>
<i>DZP 08 01 f6 V</i>	<i>medium to tall (6), normal leaf</i>
<i>DZP 08 01 f6 R</i>	<i>medium to tall (6), semileafless</i>
<i>DZP 08 01 f4 V</i>	<i>tall (7), normal leaf</i>
<i>DZP 08 01 f4 R</i>	<i>tall (7), semileafless</i>
<i>Karolina</i>	<i>tall to very tall (8), normal leaf</i>
<i>Szarvasi Andrea</i>	<i>tall to very tall (8), semileafless</i>

All of them in combination with

Wintertriticale (seed density 120 seeds/m²)

<i>Agostino</i>	<i>medium after winter, late ear emergence, short</i>
<i>Vuka</i>	<i>planophile after winter, medium ear emergence, broad leaves, tall</i>
<i>Securo</i>	<i>erectophile after winter, medium ear emergence, very tall,</i>

Changes for 2019/2020

Winterpeas (seed density 75 seeds/m²)

Implemented new

DZP 08 03 c7 V *medium (5), normal leaf*

DZP 08 03 c7 R *medium (5), semileafless*

DZP 08 01 e V *very tall (9), normal leaf*

DZP 08 01 e R *very tall (9), semileafless*

Pandora V *tall (7), normal leaf*

Kolinda R *tall (7), semileafless*

Excluded

DZP 11 03 b V *short (3), normal leaf*

DZP 11 01 e R *short (3), semileafless*

DZP 08 01 f6 V *medium to tall (6), normal leaf*

DZP 08 01 f6 R *medium to tall (6), semileafless*

List of traits assessed

<i>Crop development and agro-ecological performance (phenology, weeds, diseases, ...)</i>		
Trait	How it has been assessed	Type of data available
Height in April	Measure in cm transferred into score	cm and score
Height in June	Measure in cm transferred into score	cm and score
Date of ear emergence	Date	date and score

<i>Crop productive performance (yield, yield components)</i>		
Trait	How it has been assessed	Type of data available
Yield of pea samples	Weight after threshing and drying	dt/ha
Yield of triticales	Weight after threshing and drying	dt/ha
Yield combined	Weight after threshing and drying	dt/ha

Trial background and hypothesis

Under organic farming in the middle-north of Germany growing of winter peas can be done best in mixture with triticale, because it has a better performance and is later ripening than barley, is not as much shadowing like rye and can compensate yield, if peas are reduced by weather conditions. Peas can differ first of all in height and leaf type related to the question, which type would be best in yield to combine with triticale, but also whether there is an influence of triticale to yield. The trial shall give hints for which type of winter pea should be used in mixtures and whether height and leaf type have an influence on yield.

Trial design and management

Ten winter peas, representing 5 different types in height, each as one with normal leaf type and one with semi leaf type and where possible as isogenic lines, were combined with three different triticale varieties on plots of 3,125m² with three replications (90 plots in total as randomised block design). Date of sowing was Sept. 17th, 2018. A mechanical hoeing was done on Nov. 6th, 2018. Harvested with plot combine on July 19th, 2019. Dried with cold air and separated with sieves and spiral separator. Statistical variance analyses were done as cross classification for yield (pea – triticale – combined).

Additional to the yield trial, all accessions were maintained each in five single plant descendant plots with single plant harvests and rest plot threshing.

Participatory and multi actor approaches

On a pea field day on May 25th, 2019, the trial was presented to farmers and consultants, where the discussions faced to the trial and with respect to farmers experiences during the last three extremely different years related to very wet and very dry conditions ended in the following preferred type of winter pea: A winter pea for combination with triticale from farmers view should be white flowering with white kernels with high protein for threshing, relatively tall (score 6-9) and give also a good plant/leaf mass production beneath grain yield. The reason for this is the possibility to use the green plants alternatively for feeding in very dry years, where not enough feed is available at all. This outcome will be the reason to reduce the number of short types of peas for the season 2019/20 and extend the number of medium to tall types.

Main results

Unfortunately peas disappeared more or less during winter and spring. Where the plots looked best with good growing of peas, there was also no satisfying pea yield, which reached from 0.9 to 4.8 dt/ha on average, where up to 25 dt/ha was expected. The extremely dry spring in combination with stem diseases seemed to be the reasons. Nevertheless variance analyses could help to show, that there was a very high significant difference in pea yield related to the pea varieties ($<0,01$), but not related to the combining triticale. For yield of triticale from 21.7 to 25.5 dt/ha on average there was a very high significant difference ($<0,01$) related to triticale varieties and a low significance related to the combined peas. For the total yield of the combinations there was only a very high significant difference for the different triticale varieties. No significance could be found for any kind of interaction between pea and triticale related to separated or total yields.

With triticale VUKA, which has very broad leaves, highest yield of combinations and of triticale on average could be reached. Vuka could compensate best, in particular with a medium type in length and a semileafless type of pea (DZP1009e1R). Highest pea yield could be found with the very tall normal leaf type KAROLINA.

Discussion

For interpretation of results has to be taken into account the very low yield of the peas in this season and the more or less normal development of the triticale. Total yield under these circumstances was influenced mainly by the triticale varieties, but not the pea varieties, which means that peas and triticale compensate each other, whatever the type of pea is, but the level of triticale yield brought the highest influence on total yield at all. The yield of the pea varieties was different, but not significantly influenced by triticale varieties. The shortest peas gave the lowest yield and the tallest with normal leaf type the highest. But it could not be shown, that the leaf type has an influence on yield over all five types of plant length. The yield of triticale itself was also influenced by the type of pea. In particular the very tall pea varieties Karolina and Szarvasi Andrea suppressed the triticale yield significant. But for total

grain yield it could not be distinguished, whether also a medium tall semileafless type will be best for balanced high yield at all.

Conclusion and next steps

Because of the loss of peas during the growing season, the results are not sufficient and the trial has to be repeated in 2019/20. But because of the extreme low yield of the short peas, which were shorter than the shortest triticale, they will be exchanged. And the lowest yielding medium to tall types will be exchanged also. Two pairs of isogenic type of tall peas will be taken from the available breeding collection. This shall help to get more clearness about the influence of leaf type on a level of taller pea plants. As the triticale has such an influence on the total yield, it should be given more research on more different varieties of triticale in combination with medium to tall peas to increase the yield of the mixture of both.

Supplementary material

Variance analyse	Discard nullhypothesis		
	yield pea	yield triticale	total yield
between peas	Yes ***	Yes *	No
between triticale	No	Yes ***	Yes ***
Intereaction peaXtriticale	No	No	No
rest	No	No	No

level of significance *= $<0,05$ **= $<0,01$ ***= $<0,001$

YIELD in dt/ha	yield of pea (STDDEV: 0,24 dt/ha)			
Name	Agostino	Vuka	Securo	Average
DZP1103bV	1,3	0,6	0,9	0,9
DZP1101eR	1,0	0,2	1,4	0,9
DZP1009d4V	1,7	1,0	1,8	1,5
DZP1009e1R	3,1	2,7	3,4	3,0
DZP0801f6V	0,7	2,4	1,0	1,4
DZP0801f6R	1,0	0,0	1,3	0,8
DZP0801f4V	1,8	1,6	3,0	2,1
DZP0801f4R	1,9	1,6	3,3	2,2
KarolinaV	4,8	6,1	3,5	4,8
SzarvasiAndreaR	3,5	1,8	2,8	2,7
Average	2,1	1,8	2,2	

YIELD in dt/ha	yield of triticale (STDDEV: 0,69 dt/ha)			
Name	Agostino	Vuka	Securo	Average
DZP1103bV	25,2	28,2	21,9	25,1
DZP1101eR	24,4	27,8	22,6	24,9
DZP1009d4V	26,5	28,1	21,8	25,5
DZP1009e1R	23,9	28,0	20,5	24,1

DZP0801f6V	26,6	26,3	21,0	24,7
DZP0801f6R	24,7	25,7	21,0	23,8
DZP0801f4V	24,2	26,5	20,7	23,8
DZP0801f4R	24,3	26,3	20,1	23,5
KarolinaV	22,7	23,2	19,4	21,7
SzarvasiAndreaR	23,4	23,9	18,6	22,0
Average	24,6	26,4	20,7	
YIELD in dt/ha	combined yield (STDDEV:0,63 dt/ha)			
Name	Agostino	Vuka	Securo	Average
DZP1103bV	26,3	28,6	22,6	25,9
DZP1101eR	25,2	27,8	23,7	25,6
DZP1009d4V	28,0	28,9	23,4	26,8
DZP1009e1R	26,7	30,5	23,7	27,0
DZP0801f6V	27,1	28,5	21,8	25,8
DZP0801f6R	25,6	25,5	22,2	24,4
DZP0801f4V	25,7	27,9	23,5	25,7
DZP0801f4R	25,9	27,7	23,2	25,6
KarolinaV	27,3	29,1	22,7	26,4
SzarvasiAndreaR	26,7	25,5	21,2	24,5
Average	26,5	28,0	22,8	