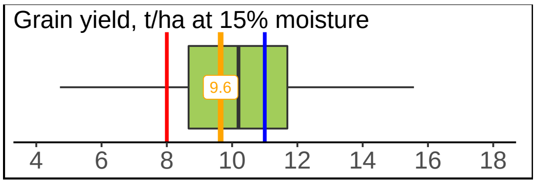
Entrant's Report

Harvest 2020

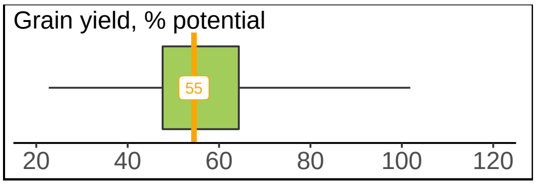
YEN User ID: CF00001	Field/Site name: Home
Entrant name: Example	Location: East Anglia
Main contact email: xxx.xxx@home.com	Incident energy 2019-20: 35 TJ/ha
Sponsor/supporter: Gt Help	Available water: 416 mm
Sponsor/Supporter email: gt.help@sponsor.com	Crop: Winter wheat
	Variety: KWS Lili

SUMMARY: YEN entries were completed from 168 fields and 17 trials in 2020. Headline results for your entry are shown in benchmark diagrams below. Your yield of 9.6 t/ha ranked 90th within all YEN entries. This represents 55% of its estimated yield potential of 17.7 t/ha, which ranked 78th within all YEN entries in 2020.



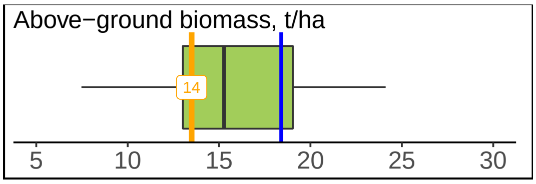
Yield rank:

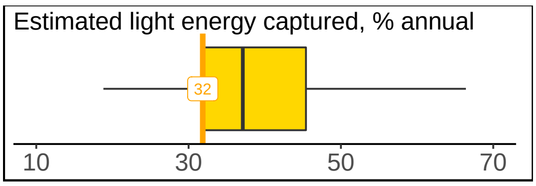
90th

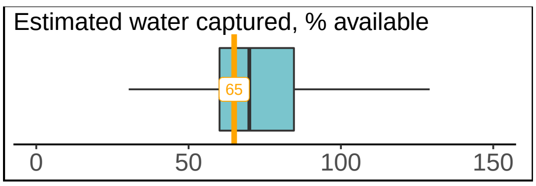


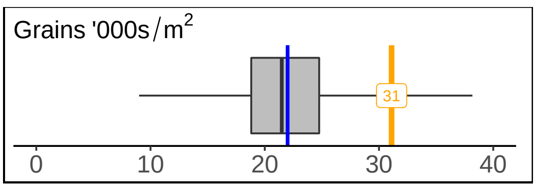
Potential yield rank:

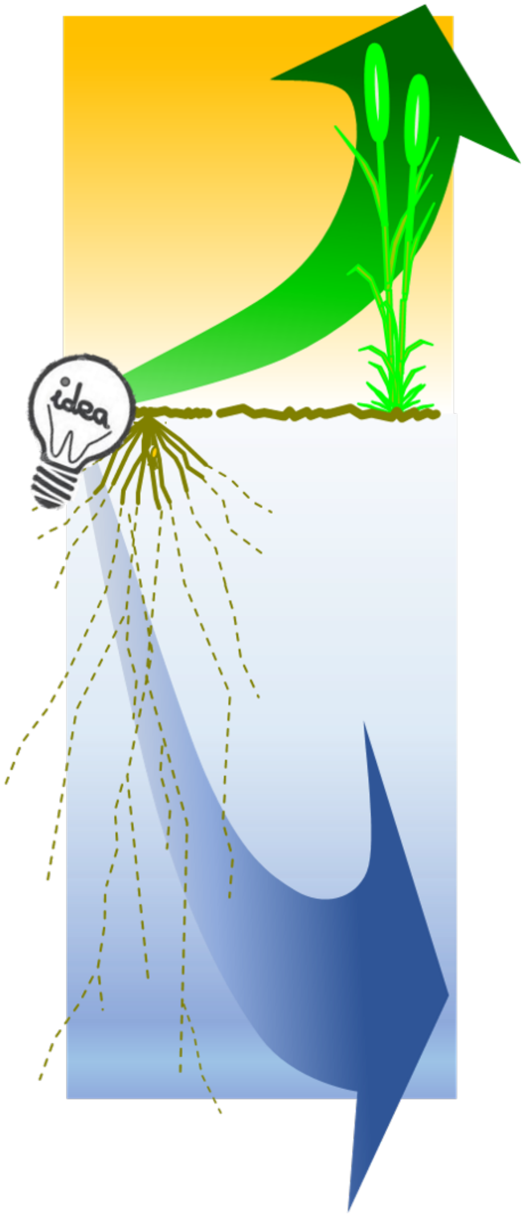
78th











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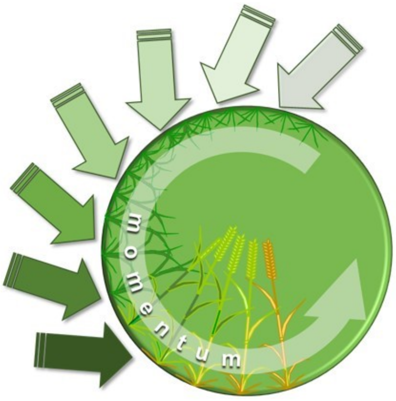
Our detailed analysis of your yield result is provided in the following pages, including comparisons with other YEN entries and with benchmarks taken from the AHDB Wheat Growth Guide and the AHDB Nutrient Management Guide (RB209). We hope that this helps you to identify aspects of your husbandry and growing conditions that offer possible routes to further yield enhancement on your land.

Our approach in this report is to consider yield potentials and growing conditions for crops in the 2019-20 season, then the conditions of your crop, its development, its basic resources (light energy, water and nutrients), its success in capturing these and in converting them to grain. Lastly, we use grain analysis to provide a post-mortem on your crop's limiting components and nutrition.



"The YEN exists to help you to enhance your yields."

The key to high yields amongst YEN entries has been called 'momentum' – maximising growth by avoiding setbacks. So, our approach to enhancing yields is to work out what limits growth – light energy, water, nutrients, or storage capacity – and then develop ideas to build better canopies, better roots, more stores, or supply deficient nutrients accordingly.

To estimate potential yields, we assume a theoretically 'perfect' variety grown with 'inspired' husbandry on your land with its 2019-20 weather, achieving either:

(i) **60% capture of light energy** through this season (including some in August), and its conversion to 1.4 tonnes of biomass per terajoule, or

(ii) **Capture of all the available water** held in the soil to 1.5 m depth (or to rock if less) plus all rainfall from April to July, and conversion of each 18 mm into a tonne of biomass per hectare.

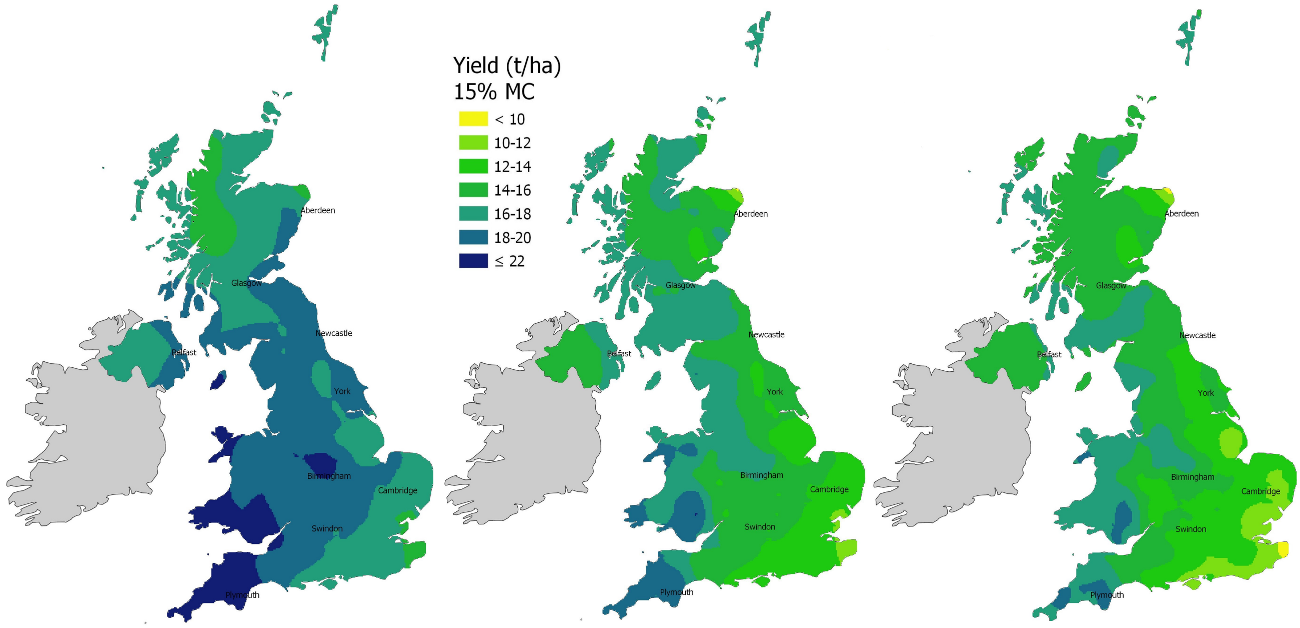
Taking the lesser of these two biomass amounts, we assume that a maximum of 60% can be used to form grain, this is the 'harvest index'. Note that we assume average temperatures for the UK, and no damage from waterlogging, frost, heat, or lodging.

NB: Our new model of potential yield for 2020 estimates growth and limiting resources daily (not monthly); impacts from water limitation are increased and more common than in previous YEN reports.

The maps below show the potential grain yields for autumn and spring sown crops (i.e. before or after 1st Feb.) on retentive and light soils in 2020. For this we assume deep soils with no irrigation. They ranged from 12 t/ha upwards so, on most soils, high yields were theoretically possible almost everywhere.

2020 Potential yields

2020 Autumn sown on retentive soil (260 mm AWC) | 2020 Autumn sown on light soil (160 mm AWC) | 2020 Spring sown on light soil (160 mm AWC)

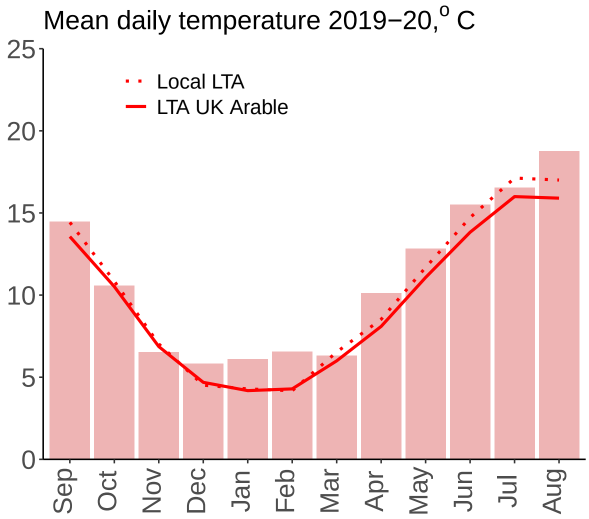


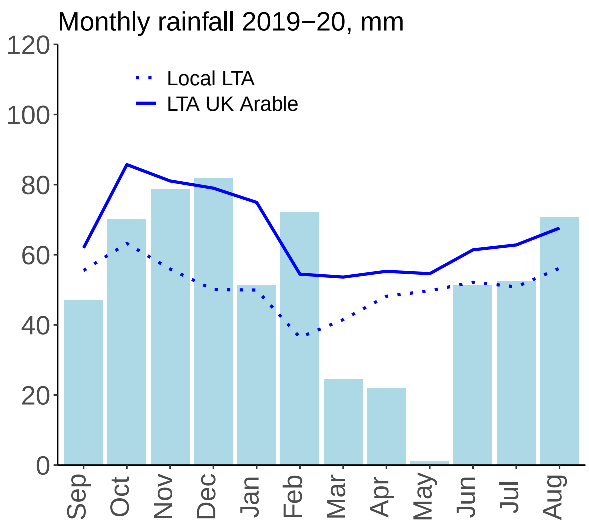
We are using weather data from DTN^{TM} in 2020. Note we do not have long term met data from DTN so cannot show a map of long-term average yield potentials.

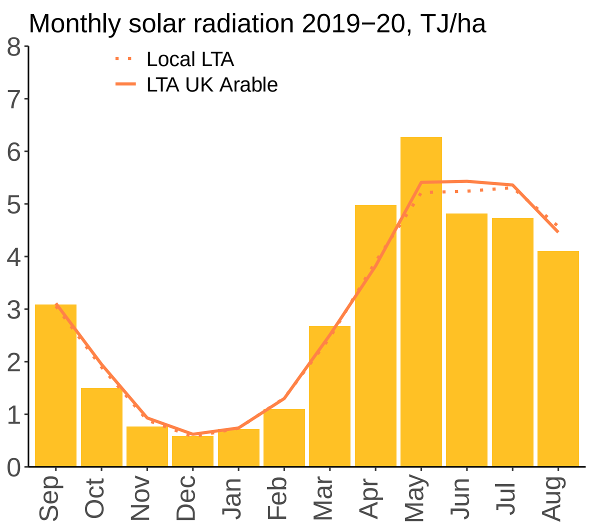
The season's weather

The adjacent graphs show the monthly temperatures, rainfall and total solar radiation for your area in 2019-20 compared to your regional long-term average (LTA) and the average for all UK arable areas (1981-2010, from the Met Office).

This growing season was challenging! In September, the lead-up to establishment was wet in the North and (deceptively) warm and dry in the South. Then the autumn turned wet especially in the north and particularly in Lincolnshire, before most crops had been sown. December continued wet, especially in the south, but was warm. January was drier in the north, but then February, whilst still warm, saw three storms and a veritable deluge everywhere. March then turned suddenly dry and sunny and this continued through April especially in the north and onwards through May especially in the south. Although June was still warm some rain relieved concerns about increasing drought and it was sunny especially in the east. July was duller but cool, so canopies that had survived well were able to persist. Frequent rain in August delayed harvest for many crops, except those in the far south east.







Overall crop progress

Drilling was much delayed and reduced by wet weather conditions leaving soils unworkable for much of the autumn and limiting applications of sprays and fertilisers.

Total UK wheat sowings were down >20% and winter barley down 26% on the last 5 years; most winter wheat was drilled late (but before the end of November); the remaining acreage was drilled in spring as soil conditions improved.

Crop establishment was patchy on heavier soils where crops were sown into wet seed beds in October and November. Low-lying areas of fields sat flooded or waterlogged for much of the winter. A few crops were written off during January and February either due to poor establishment or grass weed burdens where pre-emergence herbicides could not be applied.

Wet weather over winter saw a rise in slug activity in January and February on later sown crops. Pellets could not be applied, and a few crops were lost due to slug feeding, especially in wetter areas of the Midlands. Slug activity decreased in March due to the drier weather.

Late sowings resulted in a marked reduction in the amount of black-grass present in crops, even in crops that missed a pre-emergence herbicide. Also, given that herbicides were often not applied until March, broadleaved weed incidence was less than expected.

A proportion of fields remained too wet to plant in autumn or winter so spring cereal areas increased – spring barley by 55%, but also spring wheat and oats. However, spring seedbed quality was variable, with topsoils moving rapidly from waterlogged to dry over a period of about three weeks in March.

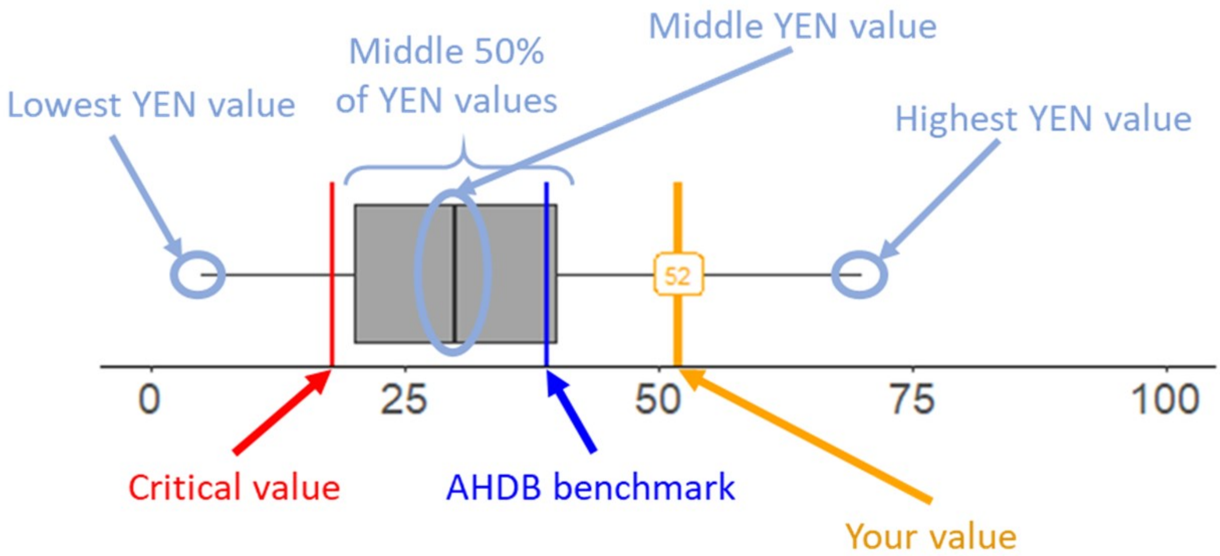
Delayed drilling and the cool autumn reduced BYDV transmission and incidence.

Dry weather and thinner crops helped to keep Septoria and eyespot in check through the spring; however, yellow rust was a concern early-on for many growers due to the lack of frosts, new races present, and vulnerability of young plants from late sowings. Disease levels were also low on both winter and spring barley. For some crops which experienced rainfall during flowering, bleached ears were indicative of Fusarium infection.

The warm year brought some early ripening and harvest of autumn drilled crops, especially winter barley. However, the frequent rain in August caused tricky harvest conditions and delays for many crops.

YEN Benchmarking charts – What do they mean?

YEN is much more than a competition – it provides a full set of metrics whereby you can gauge the performance of your crop against all other YEN crops. This has provided the principle value of YEN to most participants. We do this with benchmark charts. These compare your value with everyone else's in 2020 and with standard benchmarks and critical values, if available and appropriate. The key is as follows:



The 'whiskers' show the range of YEN values in 2020 whilst the grey box shows the middle half of values, with a line for the mid-value. The orange line shows the value for your entry, and the red line is a limit beyond which yield may be adversely affected; crops with values beyond this merit further investigation. Blue lines indicate benchmark values e.g. from the AHDB's Wheat Growth Guide (these relate to a feed wheat with slow development yielding 11 t/ha). Benchmark charts throughout this report summarise data provided for all YEN 2020 winter wheat crops (they exclude barley, triticale, rye and spring wheats).

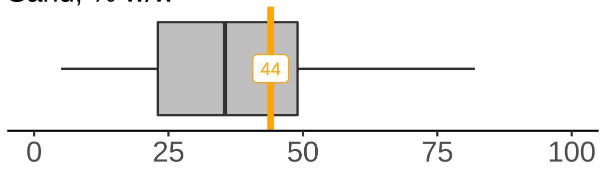
Soil assessment

Farm descriptions of topsoil and subsoil stone content, texture and depth are vital in allowing estimation of soil water holding capacity and, along with summer rainfall, the water available to your crop (see Benchmark charts in the section on 'Resources and their Capture'); this is critical in estimating potential yields.

Topsoil analyses provided through NRM's soil health service tell us texture, organic matter, OM activity and nutrient status. Ten 'soil health' traits are reported on the next page; then leaf and grain analyses are reported in later sections to help to diagnose any shortfalls in the crop's capture of soil nutrients.

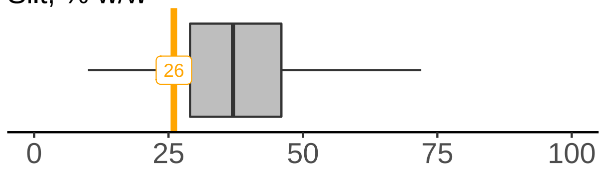
Soil analysis

Sand, % w/w



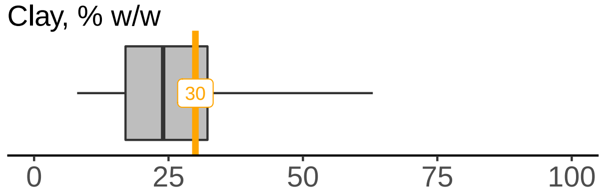
Soils with high sand content hold least water and soils with high silt content tend to hold most water.

Silt, % w/w



Soils with much silt and sand, hence less clay, tend to be relatively weak, and so are more difficult to maintain with a stable structure.

Clay, % w/w

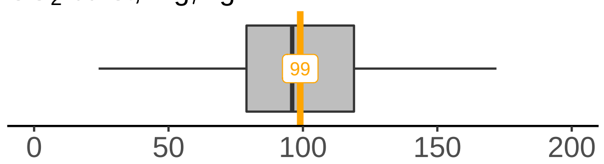


Soils with high clay content hold much water but part of this is held too tightly for the crop to use. Nutrients within this unavailable water tend to be less available than nutrients in lighter soils.

SOM, % w/w

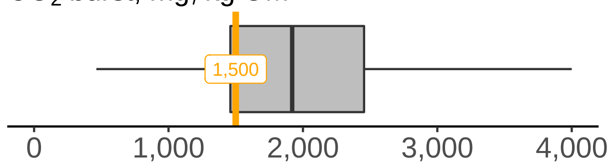
NRM determines soil organic matter by ‘loss on ignition’. Beware that SOM by other methods can give somewhat lower values.

CO_2 burst, mg/kg



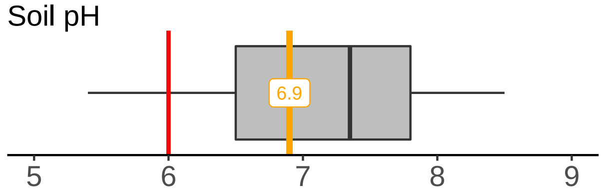
A burst of CO_2 is emitted when moist soil is incubated in air, this reflects activity of living soil biomass, hence may indicate ‘soil health’. CO_2 emissions tend to increase as SOM increases.

CO_2 burst, mg/kg OM



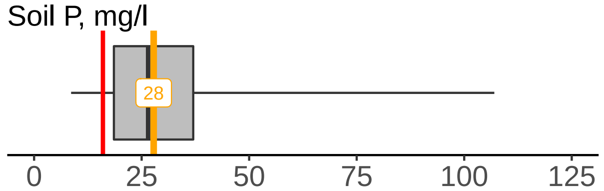
CO_2 emitted per unit of SOM shows the relative activity, hence the degree of turnover, of the soil’s organic matter. YEN data have shown less turnover in higher pH soils.

Soil pH



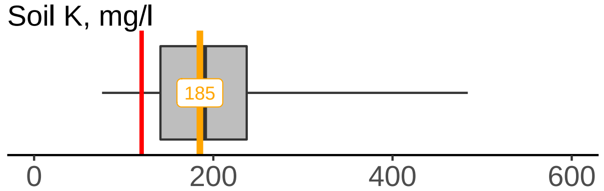
High pH soils may require that special attention is paid to micro-nutrient levels in leaf and grain (see later pages).

Soil P, mg/l



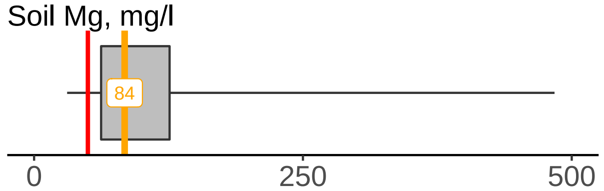
Only a small difference separates P Index 0 (<=9) and 2 (>=16). High yields are possible at P index 1 but fresh P is also usually required. Use grain P (see page 20) to check if P was sufficient.

Soil K, mg/l



Soil potassium (K) analysis checks on whether K supplies are likely to have been deficient for average crops. However, high yielding crops require very large amounts of K.

Soil Mg, mg/l



Magnesium (Mg) is a key component of chlorophyll so deficient plants show striking inter-veinal yellowing. Temporary deficiencies often occur in springs with dry topsoils.

Analysis of YEN data accumulated over the YEN's first six seasons has shown that, although season has the largest effect on yields, farms are relatively consistent in their performance. Hence it should be possible to learn from the best performing farms, and the YEN is beginning to indicate husbandry practices that are associated with high yields. In summary, we are concluding that:

i) 15 t/ha is possible almost anywhere! High yields are not restricted to just one part of the UK.

ii) Attention to detail is important. Aspects of this that appear significant include:

- following a break crop
- applying slurry and/or phosphate
- adequate N use, including multiple applications
- several PGR applications.

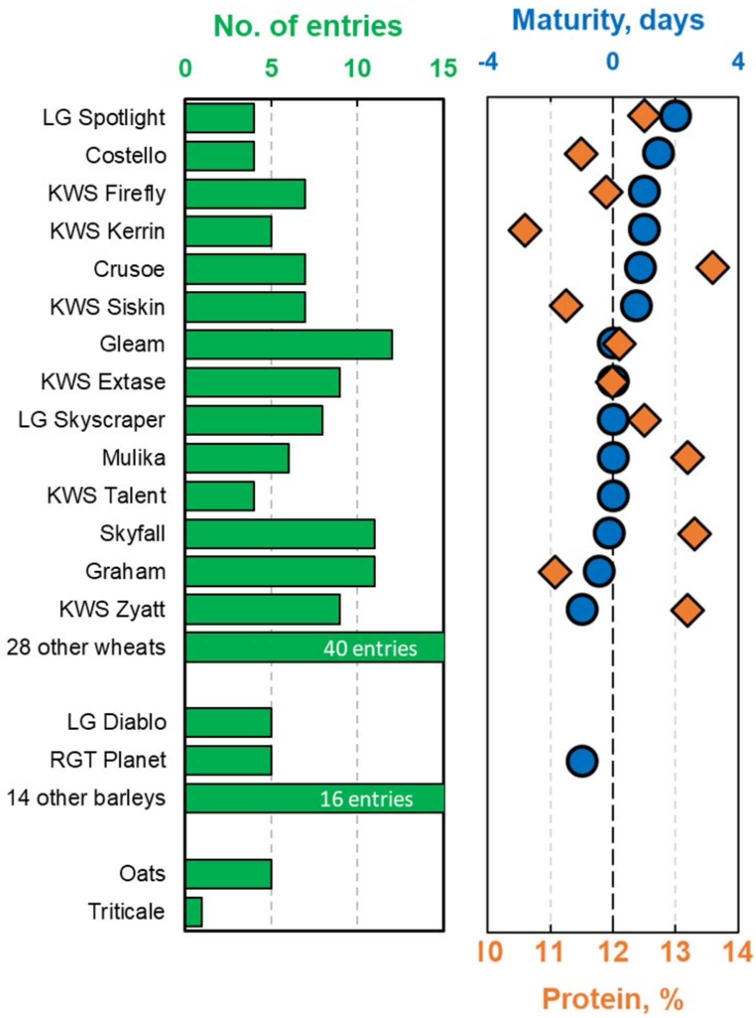
iii) Other high yield associations include:

- Weather: dry, bright autumns and winters, bright springs and cool summers
- Taller crops with more ears, higher straw N% and lower grain N%
- Nutrition: most crops suffer some deficiencies. P applied has a bigger influence than total N applied!

The following charts show how the husbandry of your entry related to all other YEN entries in 2019-20.

Variety

YEN entries in 2019-20 included 42 different wheat varieties, 16 barleys (spring barleys are reported separately this year), 2 oats and 1 triticale. Your variety was KWS Lili, which according to the AHDB Recommended List (or alternative source for some varieties) is relatively late to mature and has an average grain protein content of 11.1%

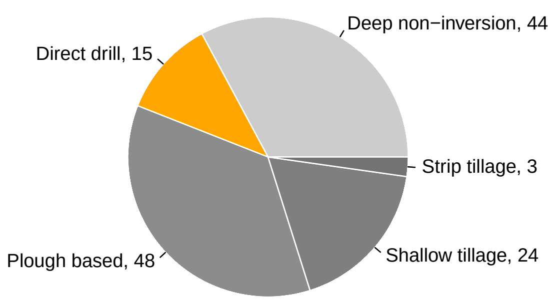


For all varieties, the protein content quoted is the normal (lower) protein content quoted from the AHDB's 2020/21 Recommended List (Summer edition) – not the 'Protein content – milling spec'.

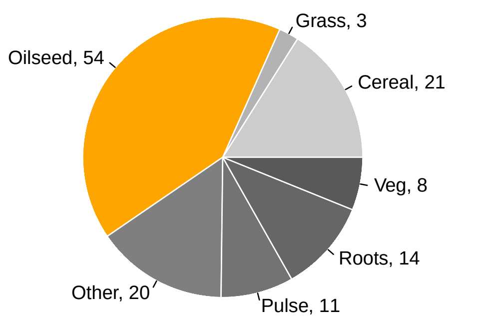
Husbandry

Orange segments or bars in the following diagrams indicate the agronomy of your crop, if known, and shows how common this practice was amongst all YEN entries.

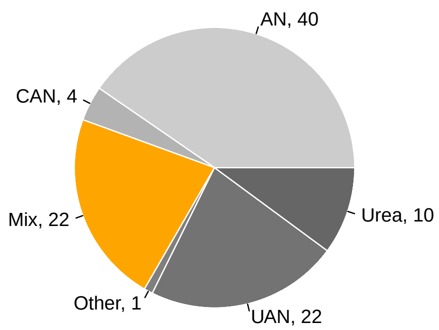
Main cultivation strategy



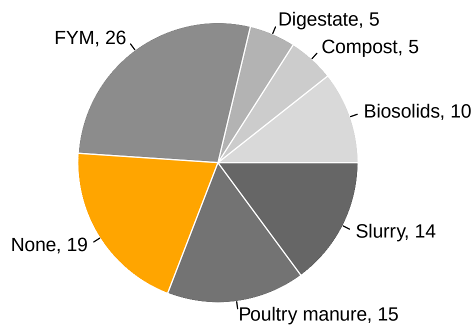
Previous Crop Type



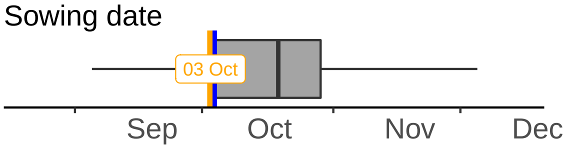
Main form of N applied



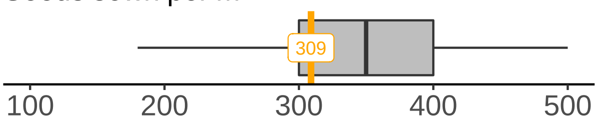
Predominant organic materials applied



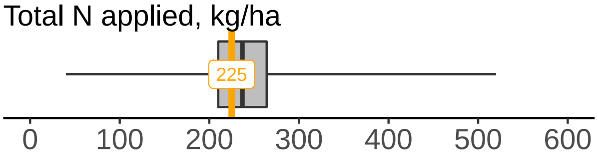
Sowing date



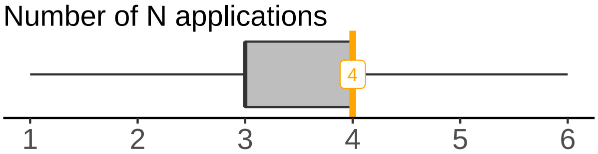
Seeds sown per m^2



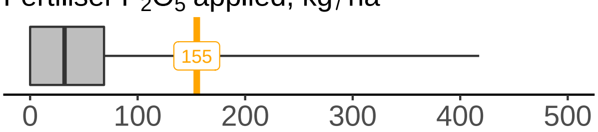
Total N applied, kg/ha



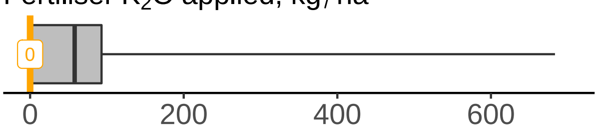
Number of N applications



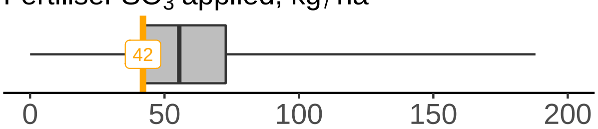
Fertiliser P_2O_5 applied, kg/ha



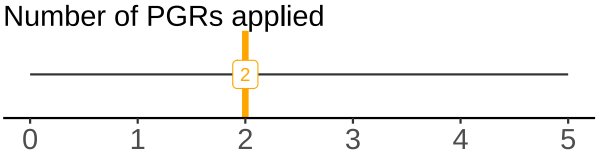
Fertiliser K_2O applied, kg/ha



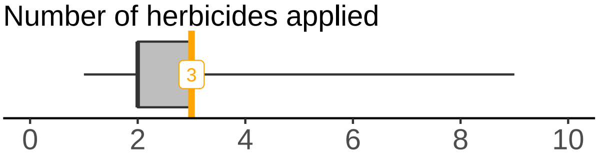
Fertiliser SO_3 applied, kg/ha



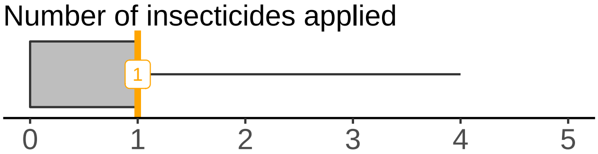
Number of PGRs applied



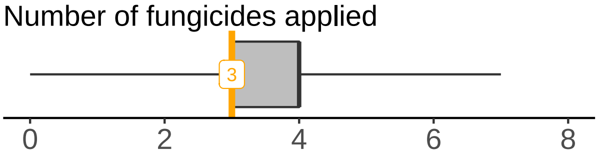
Number of herbicides applied



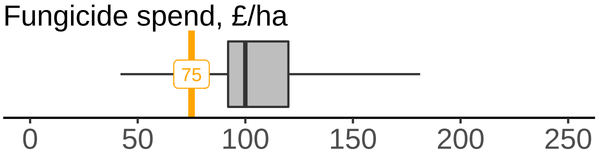
Number of insecticides applied



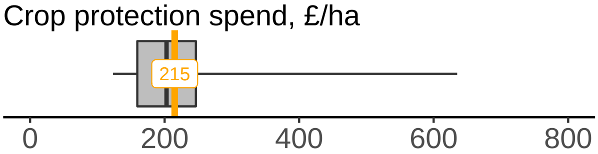
Number of fungicides applied



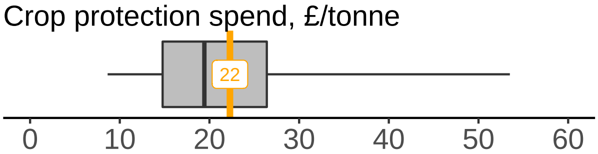
Fungicide spend, £/ha



Crop protection spend, £/ha

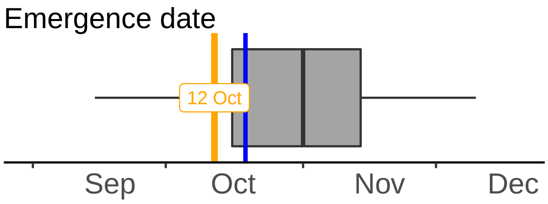


Crop protection spend, £/tonne

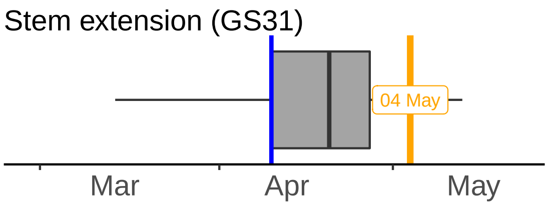


The following charts show how your entry developed through the 2019-20 season, compared to all other YEN entries and Benchmarks. The cardinal stages of emergence (GS10), start of stem extension (GS31), flowering (GS61) and full senescence (GS87) determine the length of each phase for growth:

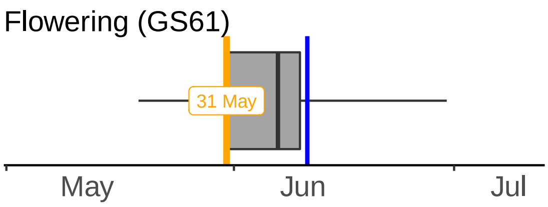
- Foundation, GS10-GS31 – when tillers and main root axes are formed,
- Construction, GS31-GS61 – when yield-forming leaves, ears and stems are formed, including soluble stem reserves
- Production, GS61-GS87 – when grains are filled, both with new assimilates and reserves redistributed from stems.



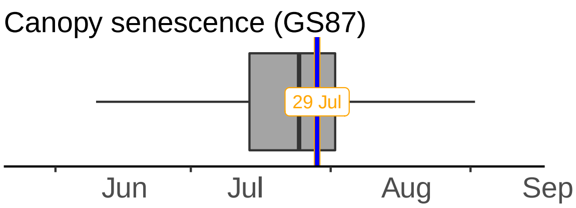
Sowing dates of winter wheats entered in YEN ranged from early Sept to early Dec. The average was 11 days later than normal, so emergence was even more delayed (13 days).



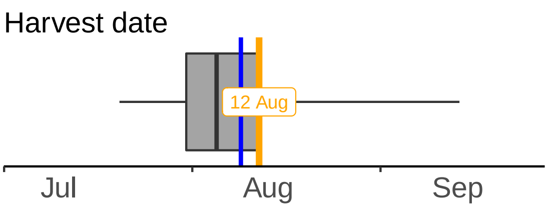
However, with the warmer than average winter, average stem extension dates were only 4 days later than normal.



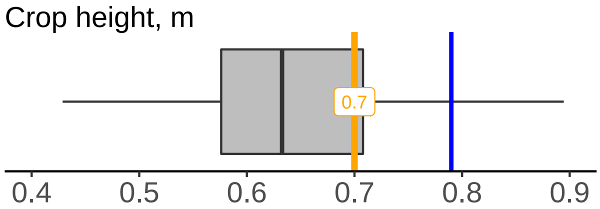
Continuing warm weather in April and May brought the average flowering date in line with normal and, despite the range of sowing dates, variation was similar to normal.



Senescence was about one week earlier than normal, even though July was relatively cool (with average rainfall, except along the south coast).



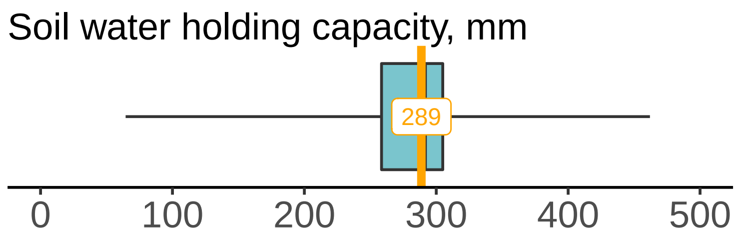
Harvest was also earlier than normal by a few days but catchy conditions during August delayed harvest of some crops.

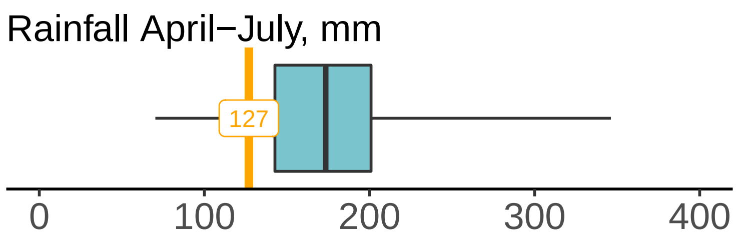


We measure height on the harvest 'grab' samples, so have to omit samples which look to have been cut above ground level. On average wheat crops appear to have been ~6 cm shorter than normal in 2020 – and like 2018.

With later sowing and later stem extension, normal flowering and early harvest, durations of all development phases were truncated in 2020, hence scope for shoot production, stem growth, and grain growth was generally less in each case. It appears that the final 'production phase' was particularly short.

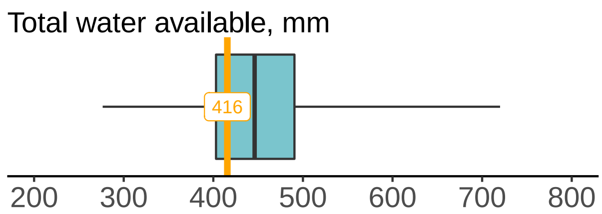
Water capture



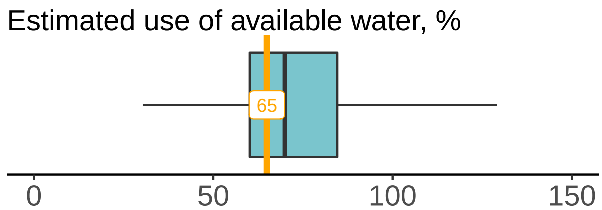


The soil water holding capacity quoted here assumes roots could access all soil water to 1.5 m (or rock, if shallower). If enough roots didn't reach this depth, soil-available water would be accordingly less.

Whilst we cannot yet measure water captured by YEN crops individually, by assuming your crop's conversion of water to total biomass was 'normal' (20 mm water for each t/ha biomass), we have made crude estimates below of the likely success of your crop's root system in capturing water.



This sums your soil's water-holding capacity and your summer rainfall (both shown above). We assume that, with a good root system, this could all become available to the crop.



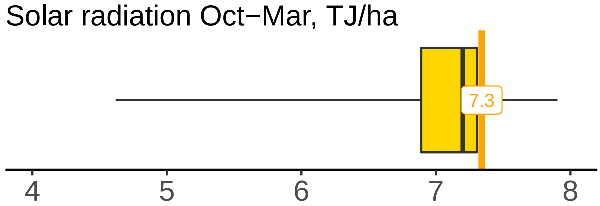
Average water use is normally greater than was achieved in 2020; small water use will sometimes have been due to less demand for canopy transpiration (e.g. because crop developed faster and matured earlier) or otherwise due to worse rooting.

A high yielding crop, growing say 20 t/ha of biomass (so yielding 12 t/ha grain at 51% harvest index), would need to capture ~400 mm water from soil plus summer rain. This is a large proportion of the water that is normally available to UK crops.

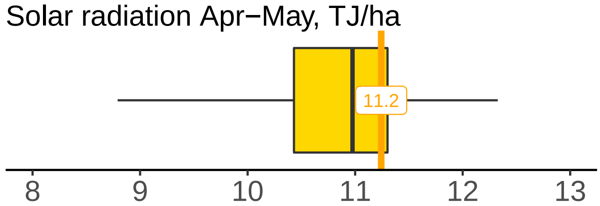
Energy capture

The benchmarking charts below show how 2020 weather affected light energy available for this entry and other YEN crops. Solar radiation has been divided into periods that roughly equate to the three key phases of crop development reported above:

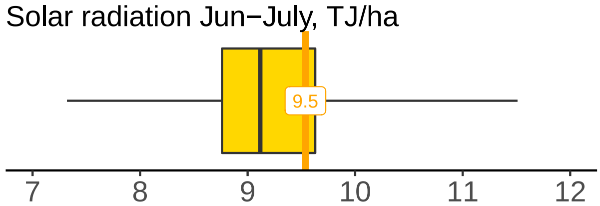
- Foundation – when tillers and main root axes are formed,



- Construction – when yield-forming leaves, ears and stems are formed, including soluble stem reserves

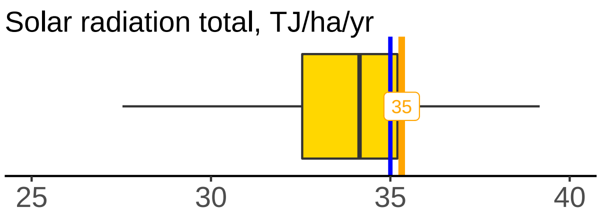


- Production – when grains are filled, both with new assimilates and reserves redistributed from stems.

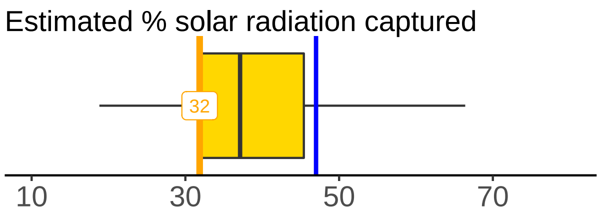


Solar radiation in September 2019 and August 2020 has been omitted, because few crops were green during those months, but crops could have achieved greater total biomass, and possibly also grain biomass, if they maintained green canopies during any part of these two months.

Whilst we cannot yet measure light capture by YEN crops individually, by assuming your crop's conversion of light-energy was 'normal' (1.2 tonnes/TJ), we have made a crude estimate below of the likely success of your crop's canopy in capturing total light-energy for the 12 months of this season.



Total solar radiation across YEN entries in 2020 was ~2 TJ/ha/year less than normal; it varied from 25 TJ/ha/year mainly in the north to 39 TJ/ha/year mainly in the south.

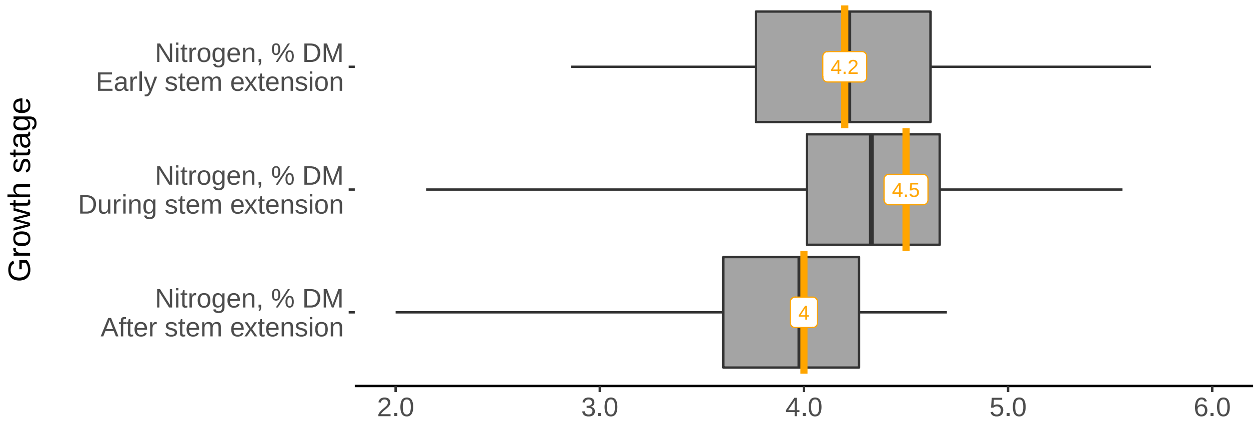


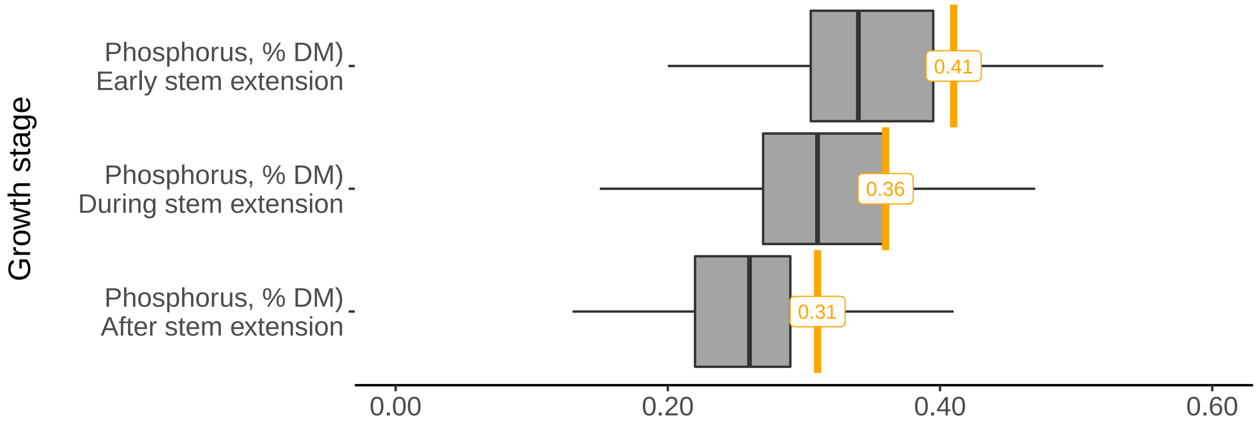
Due mainly to shorter crop lifetimes, average light capture was poor this year at 37%. The benchmark wheat crop yielding 11 t/ha intercepts 47% of annual solar radiation.

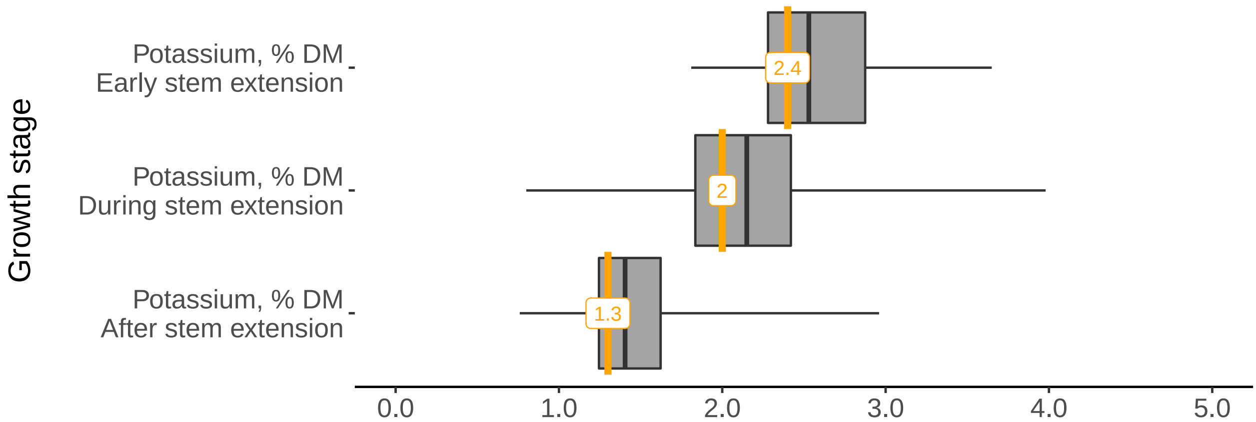
Nutrient capture

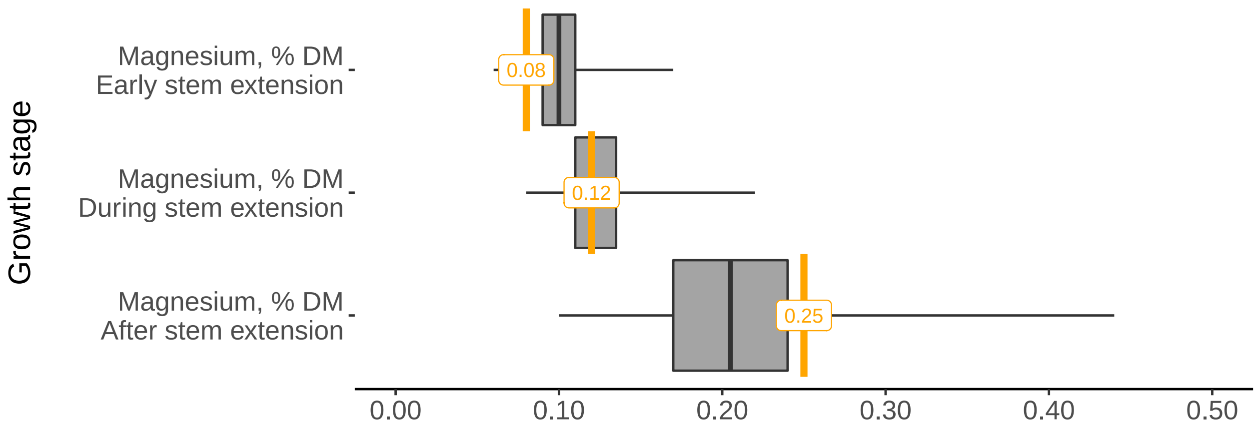
Whether nutrient capture was sufficient to support full conversion of light and water is best deduced from nutrient concentrations in crop tissues – both leaves (next three pages) and grains (later section). No critical thresholds or benchmarks are shown for leaf analyses because these change through a crop's life and are still uncertain. However, the benchmarking diagrams should enable you to compare your crop's levels with all other YEN entries in 2020, analysed at the same time.

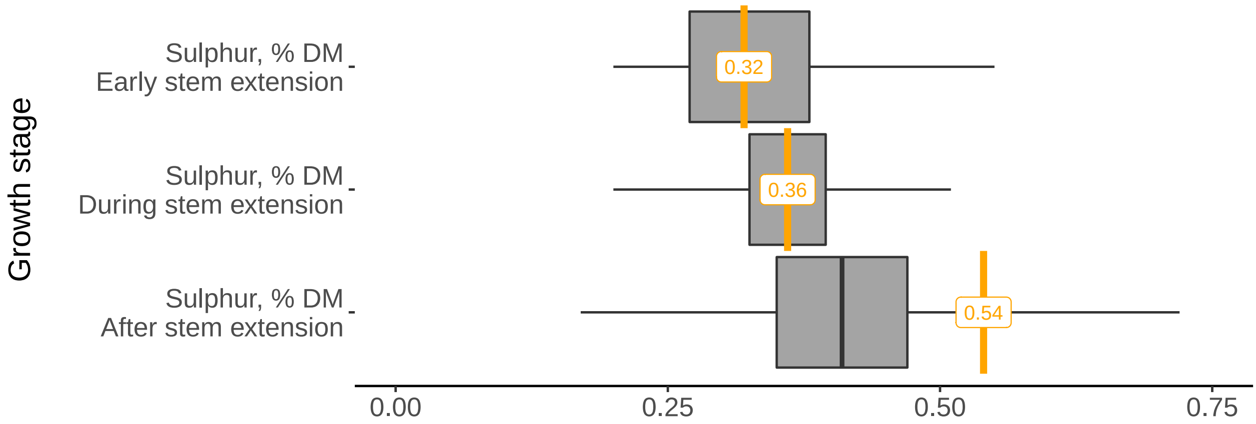
Lancrop Laboratories provide leaf analyses for YEN. Samples are of the newest fully expanded leaf.

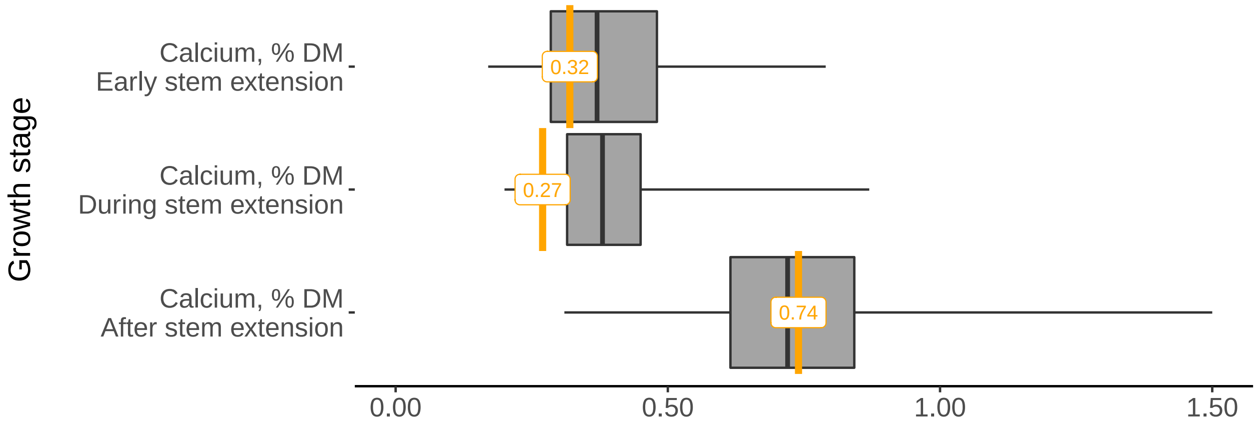

Growth stage
Nitrogen, % DM
Early stem extension
Nitrogen, % DM
During stem extension
Nitrogen, % DM
After stem extension
4.2
4.5
4
2.0
3.0
4.0
5.0
6.0

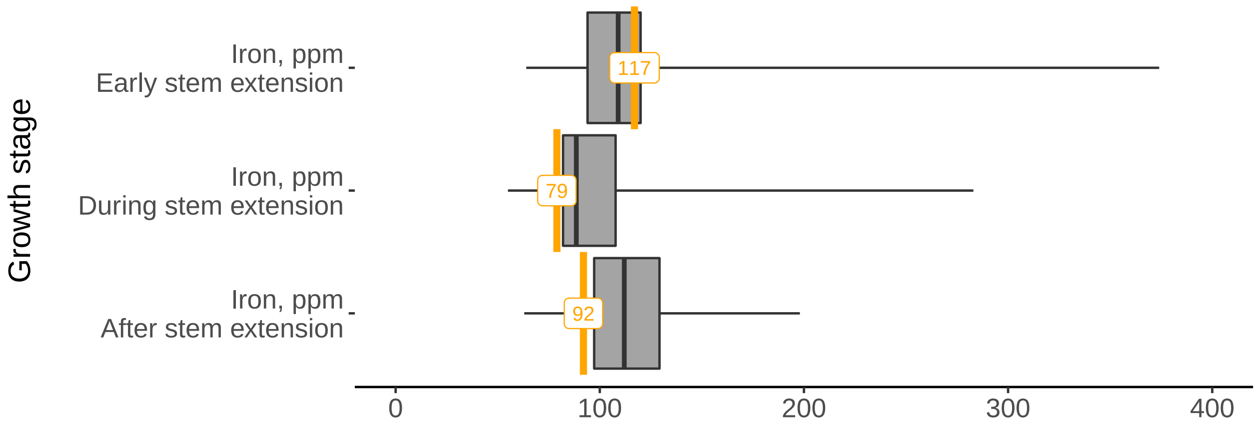

Growth stage
Phosphorus, % DM)
Early stem extension
Phosphorus, % DM)
During stem extension
Phosphorus, % DM)
After stem extension
0.41
0.36
0.31
0.00
0.20
0.40
0.60

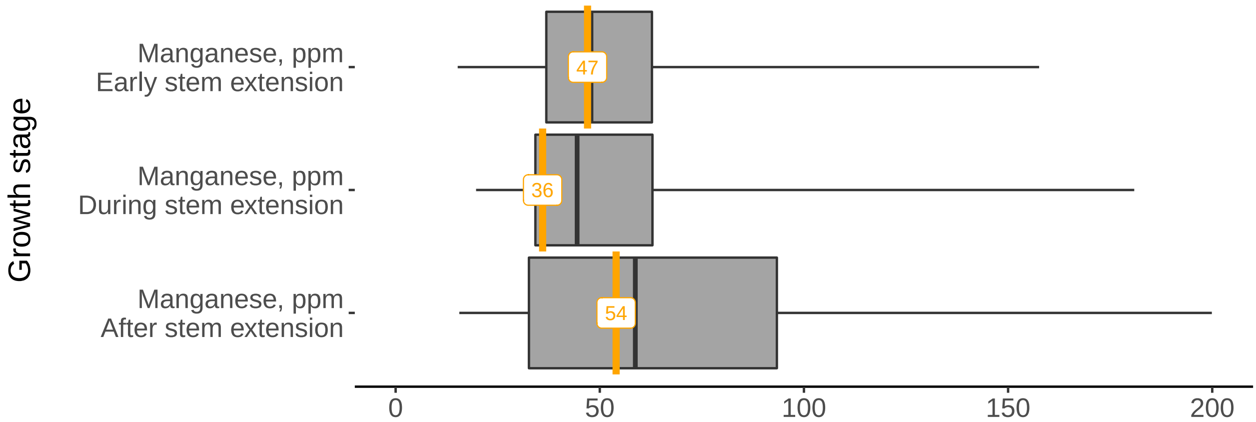

Growth stage
Potassium, % DM
Early stem extension
Potassium, % DM
During stem extension
Potassium, % DM
After stem extension
2.4
2
1.3
0.0
1.0
2.0
3.0
4.0
5.0

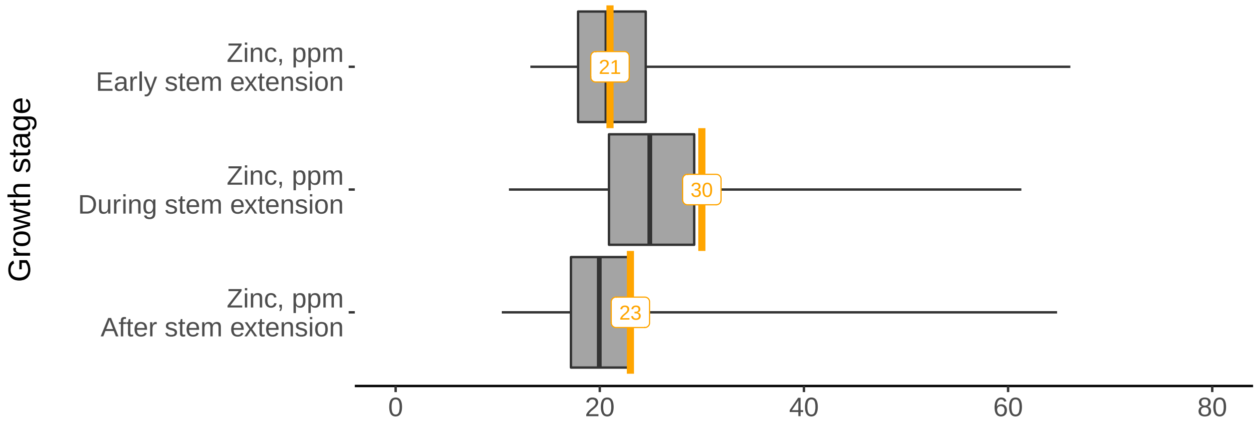

Growth stage
Magnesium, % DM
Early stem extension
Magnesium, % DM
During stem extension
Magnesium, % DM
After stem extension
0.08
0.12
0.25
0.00
0.10
0.20
0.30
0.40
0.50

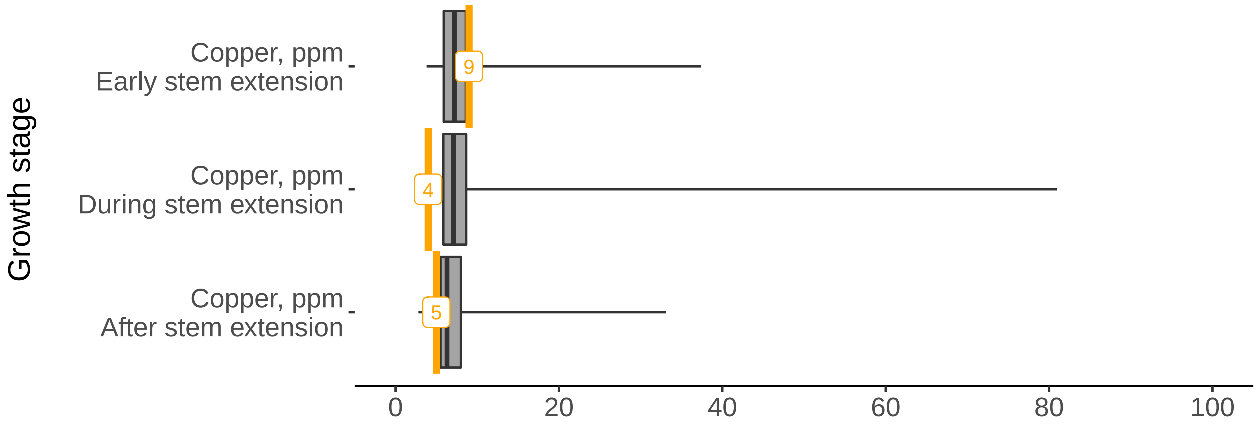

Growth stage
Sulphur, % DM
Early stem extension
Sulphur, % DM
During stem extension
Sulphur, % DM
After stem extension
0.32
0.36
0.54
0.00
0.25
0.50
0.75

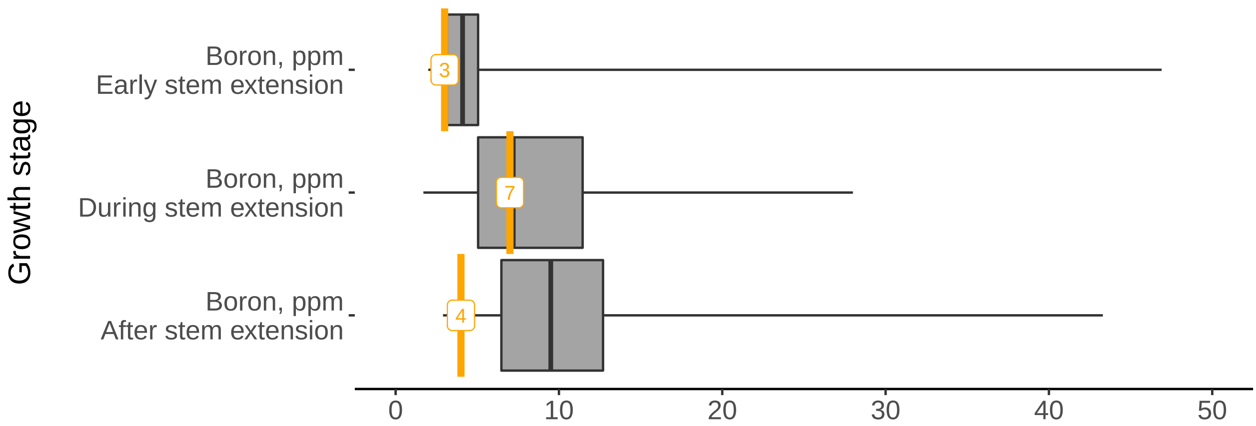

Growth stage
Calcium, % DM
Early stem extension
Calcium, % DM
During stem extension
Calcium, % DM
After stem extension
0.32
0.27
0.74
0.00
0.50
1.00
1.50


Growth stage
Iron, ppm
Early stem extension
Iron, ppm
During stem extension
Iron, ppm
After stem extension
117
79
92
0
100
200
300
400


Growth stage
Manganese, ppm
Early stem extension
Manganese, ppm
During stem extension
Manganese, ppm
After stem extension
47
36
54
0
50
100
150
200


Growth stage
Zinc, ppm
Early stem extension
Zinc, ppm
During stem extension
Zinc, ppm
After stem extension
21
30
23
0
20
40
60
80


Growth stage
Copper, ppm
Early stem extension
Copper, ppm
During stem extension
Copper, ppm
After stem extension
9
4
5
0
20
40
60
80
100


Growth stage
Boron, ppm
Early stem extension
Boron, ppm
During stem extension
Boron, ppm
After stem extension
3
7
4
0
10
20
30
40
50

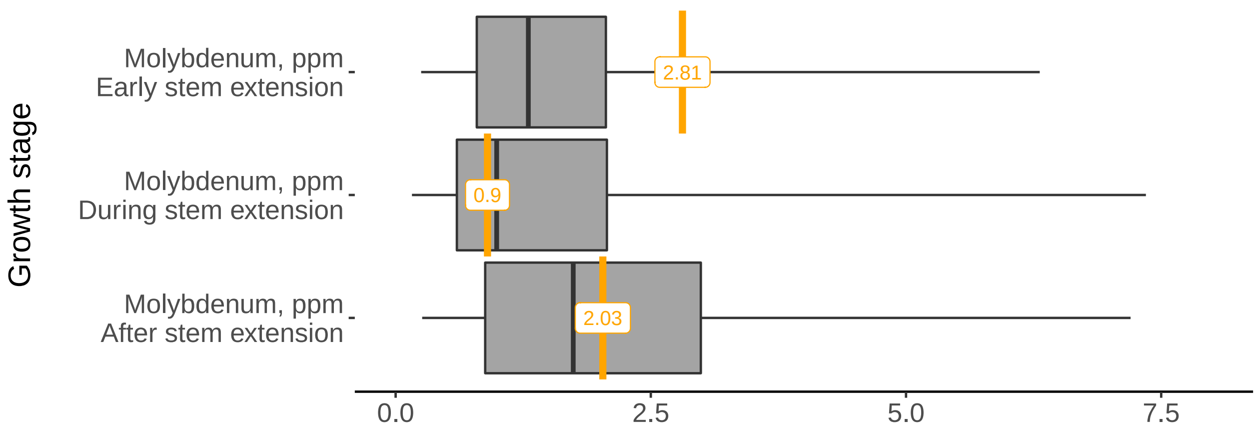
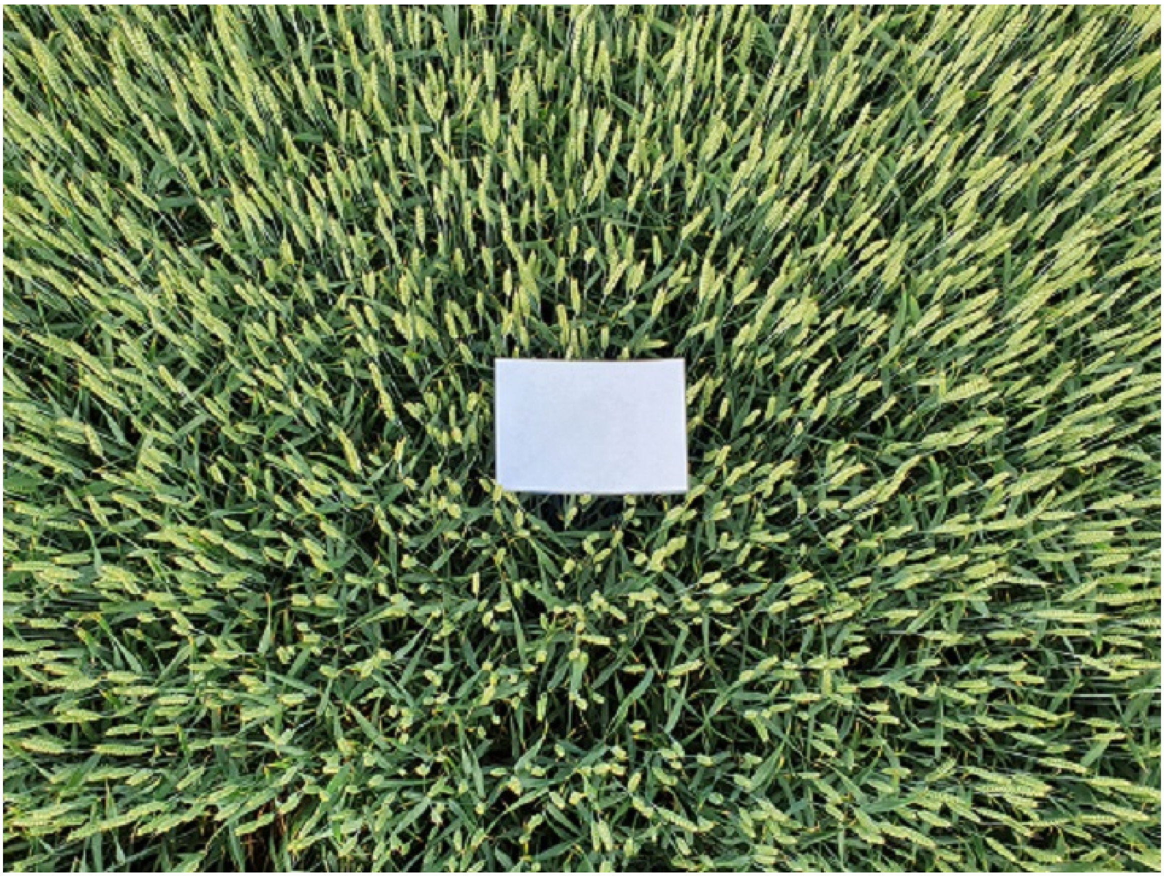
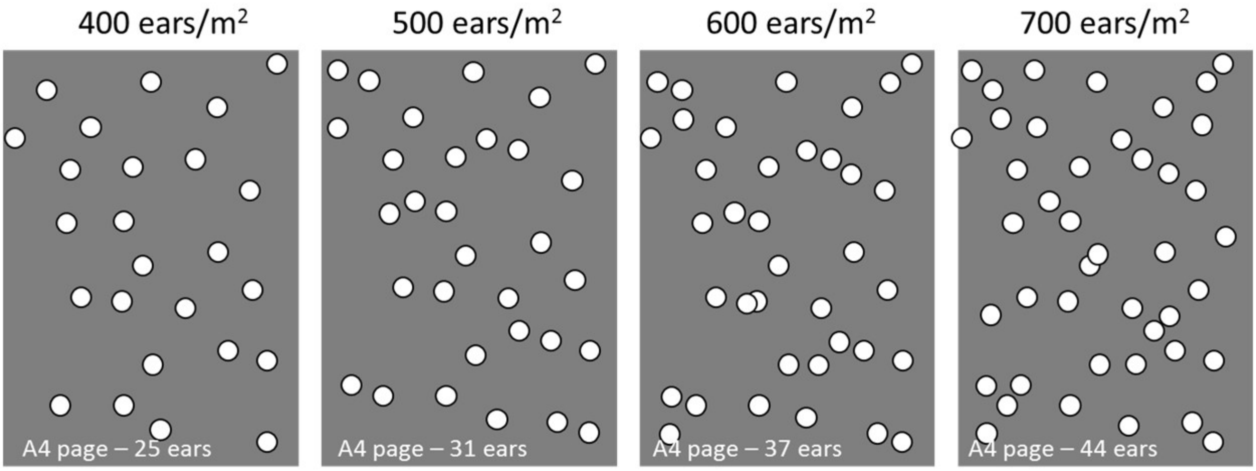

Growth stage
Molybdenum, ppm
Early stem extension
Molybdenum, ppm
During stem extension
Molybdenum, ppm
After stem extension
2.81
0.9
2.03
0.0
2.5
5.0
7.5

Image of this entry

Images are a very efficient way of collecting lots of information. An overhead photo taken during grain filling gives an impression of canopy size, nutrition and health, as well as providing an independent assessment of ears per m^2 (see diagram below). An overhead photo taken at the start of stem extension is similarly useful.



An A4 sheet of paper in your image can help to assess ear numbers per m^2, as shown here:

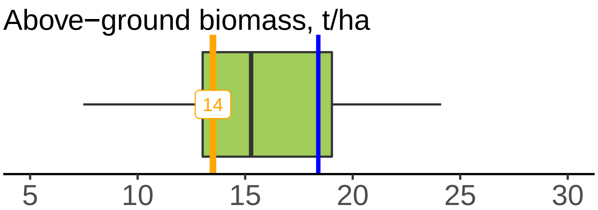


Yield formation

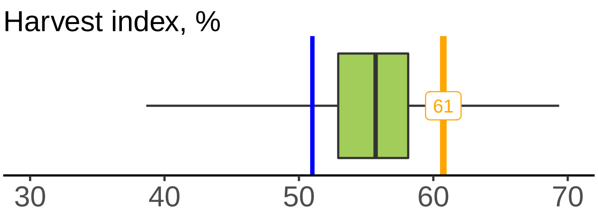
The whole-crop samples that YEN entrants provide all have their components counted and weighed and results are shown in the following charts, assuming that each sample was representative of the whole area from which grain yield was determined.

Total biomass production indicates the success with which a crop captured its key resources, light-energy and water, and the harvest index (the proportion of total biomass that was harvestable) indicates how this biomass was apportioned to grain. Since grain growth happens last, harvest index also indicates how late growth related to early growth.

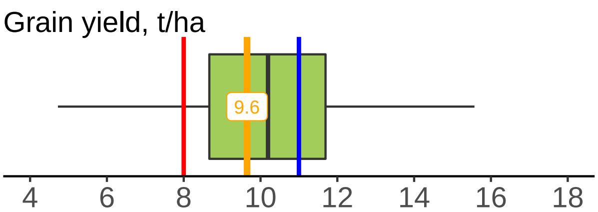
Your grain yield (expressed as t/ha and % of potential) is shown below along with biomass and harvest index, in relation to all other YEN entries and to the AHDB Benchmark grain yield of 11.0 t/ha.



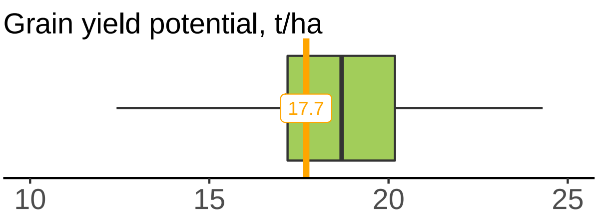
Due to late establishment and truncated development YEN entries in 2020 had less biomass on average than in any previous year. YEN experience has been that high biomass relates to high yields.



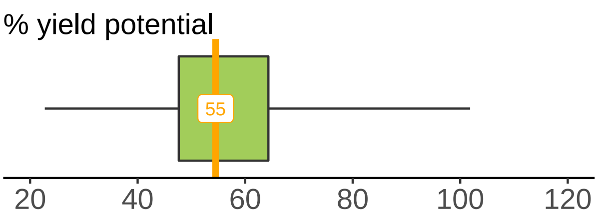
Harvest index is the percentage of total biomass that was harvestable as grain; values were quite high in 2020. Years with few fertile shoots tend to have high harvest index.



YEN yields averaged 10.4 t/ha in 2020; this compares to 10.3 t/ha in 2016 (least), and 12.7 t/ha in 2015 (most). Grain prices have been high in 2020 but yields below 8 t/ha are usually uneconomic.



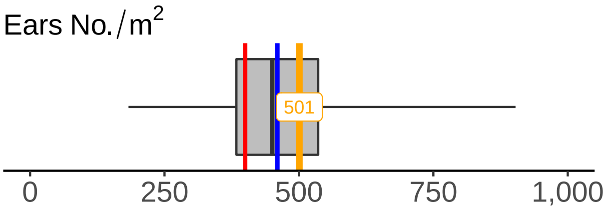
YEN yield potential is estimated from the light energy and water available at the site of your entry this year, simply converted to t/ha. We used a new model (which makes water limitation more common) to estimate yield potentials in 2020.



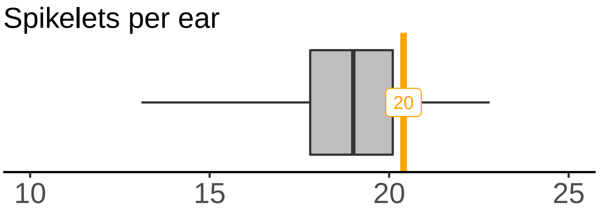
Yields achieved by YEN entries in 2020 averaged 57% of their estimated potential, the same as the average over the past 7 years of YEN.

Yield components

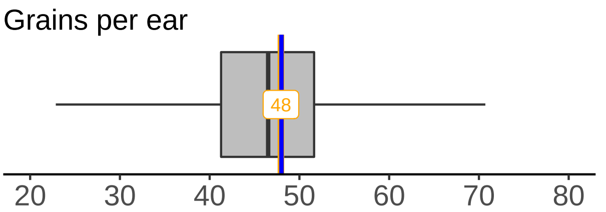
Whole crop yield analysis can also tell us about the history of your crop because the different components are determined sequentially. So comparing components of yield for your crop in the following charts with those of other YEN entrants should help to indicate the stage(s) through the season at which your crop deviated from others in 2020 and from normal (represented by the AHDB Benchmarks, blue lines).



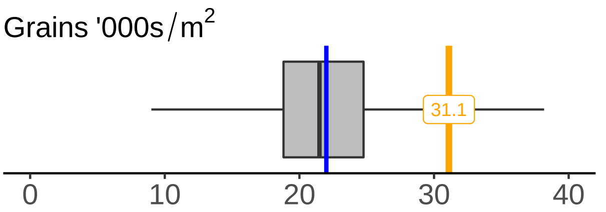
Ears per m^2 depend on plant establishment, then tillering, and then the survival of each shoot during stem extension to form an ear. Despite difficult establishment, average ear numbers in 2020 were close to the Benchmark for a 11 t/ha crop.



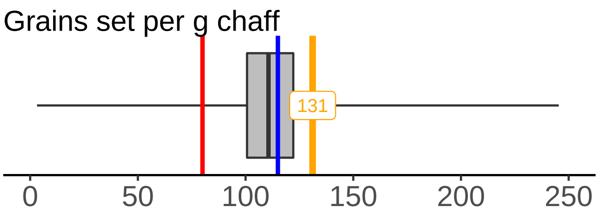
Spikelet numbers are determined between GS30 (ear at 1 cm) and GS31 (1st node). Numbers are crucial for barley but not wheat because wheat spikelets are flexible in the number of grains they set, so they can compensate.



Grain numbers were high this year. High numbers of grains (>25,000/m^2) are normally necessary for very high yields.



Grains per ear were close to normal in 2020. Grain set often compensates for variation in ear numbers, so grains/m^2 relates better to yield.



Few grains/g chaff indicates conditions around flowering may have been counterproductive. The average of 110 grains/g chaff is good this year. Less than 80/g is poor.

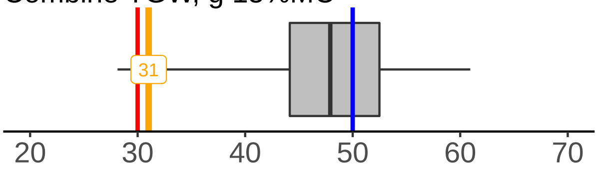
Grain formation and size

We use your combine-harvested grain sample to provide the analysis of grain size and grain filling on the next page. Grain filling depends mainly on photosynthesis after flowering, therefore it largely relies on the health and longevity of the green canopy, but sugars stored in the stem can also provide 2-4 t/ha of assimilates for grain growth and most of the protein from senescing leaves is also redistributed to form grain protein (benchmark 1.1 t/ha).

We have not measured stem sugars in YEN so far, but it is possible to assess them using a refractometer. It is likely that stem storage was less than the benchmark of 2.7 t/ha in 2020, because stems were short and numbers were not large.

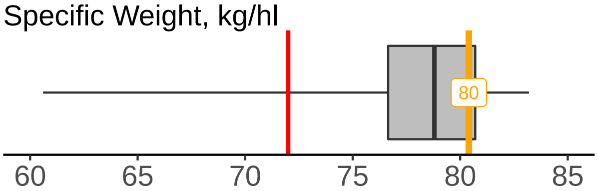
If grain number per m^2 is low (see above), or if conditions during early grain-fill are limiting, final grain filling, hence yield, may be constrained even if later conditions are good – this is sometimes described as 'sink' limitation. We try to use analysis of grain volume and grain density to deduce whether crops were sink limited.

Combine TGW, g 15%MC



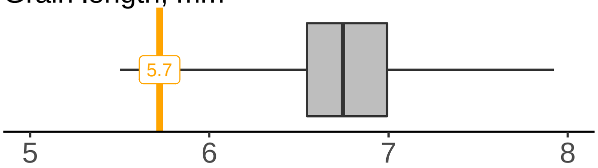
Average thousand grain weights (TGW) were normal in 2020, but ranged hugely from 28 to 61g; they can be small either because of low storage capacity (set in the 2 weeks after flowering) or poor conditions for filling, later.

Specific Weight, kg/hl



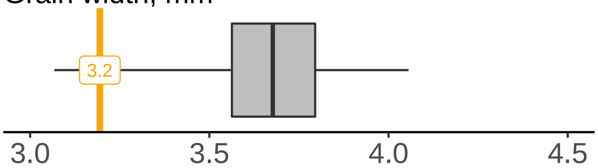
Specific weight is a quicker indicator of flour extraction than TGW and shows weights of bulk grain for storage and transport.

Grain length, mm



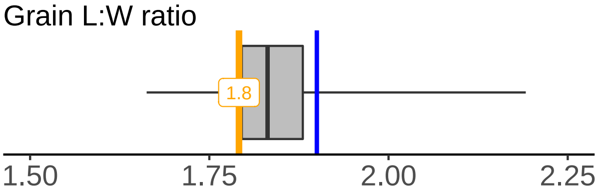
Grain length is set before grain width and tends to indicate potential grain storage capacity.

Grain width, mm



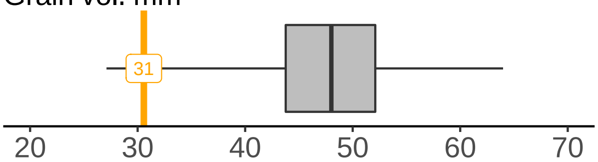
Grain width reflects the success with which grain storage capacity is filled.

Grain L:W ratio



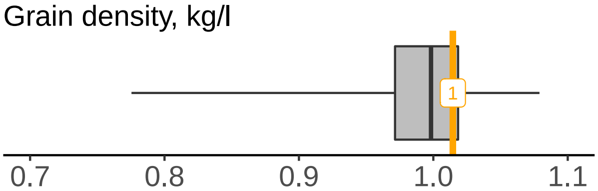
A high L:W ratio indicates that the grain may not have achieved its potential for filling, set soon after flowering. YEN grain data since 2016 show L:W of 1.9 to be 'normal'.

Grain vol. mm^3



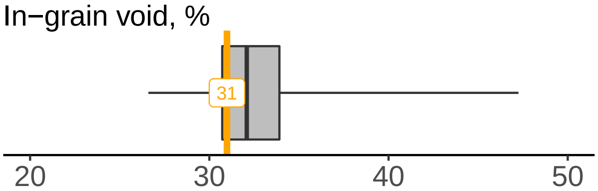
Grain volume here is the product of length and cross-sectional area, assuming grains are ovoid, so this volume includes the grain's 'crease'.

Grain density, kg/l



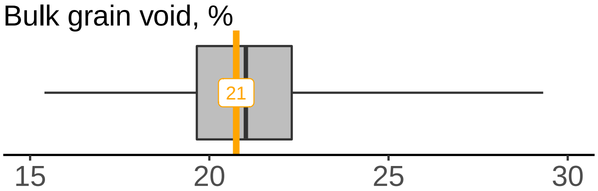
High density grains probably indicate that grain filling has been constrained by storage capacity (volume), limiting import of later assimilates – often termed 'sink limitation'. Grain density was 1.0 kg/l on average this year.

In−grain void, %



The density of starch, the main grain constituent, is 1.5, so it is possible to estimate the proportion of grains' unfilled volume. The mid-value is 32% here. This includes the crease.

Bulk grain void, %

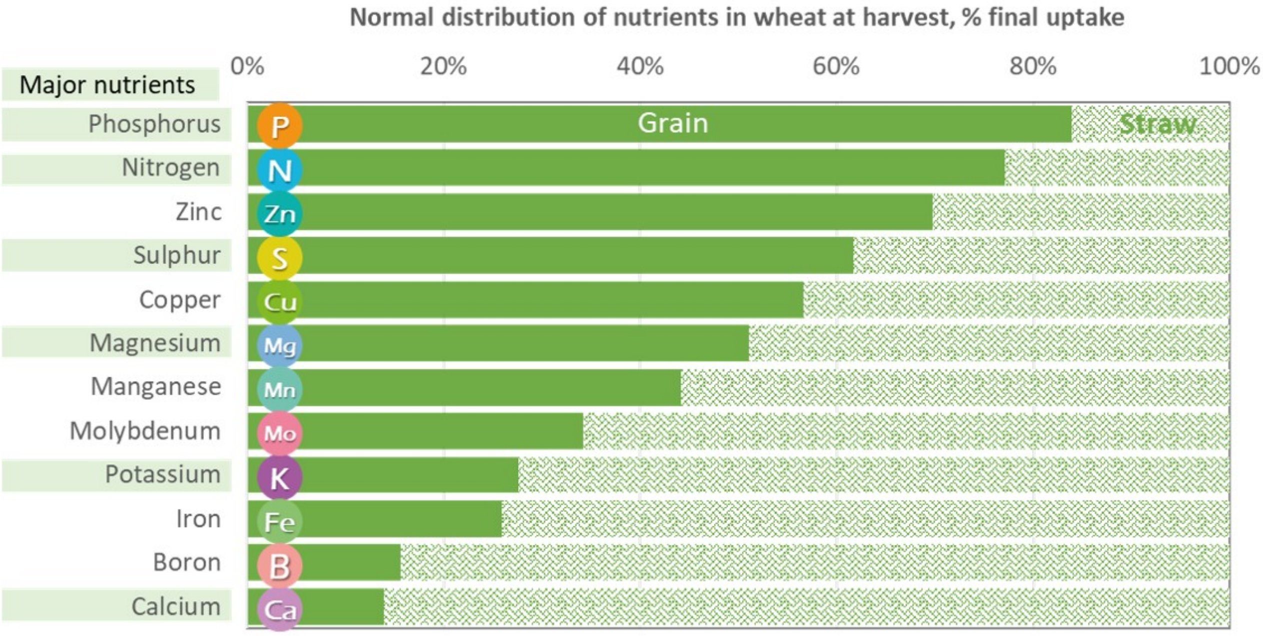


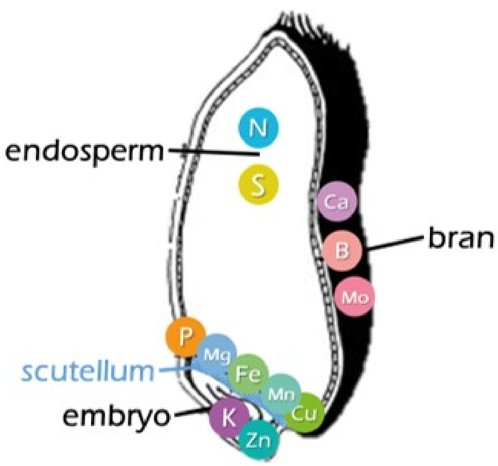
Did you know more than half of a load of grain is air?! High specific weight is achieved by having both dense grains and small voids between grains (under standard packing conditions).

CROP NUTRITION POST-MORTEM

The YEN has trail-blazed use of grain analysis to provide an overall post-mortem on each crop's nutrition.

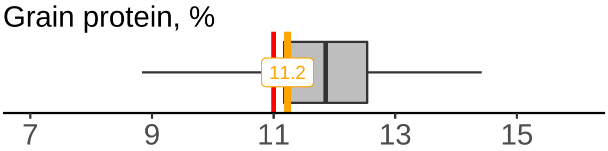
- So far, critical thresholds are only known for P, N, S and Mn in cereals. Evidence from overseas indicates less certain thresholds for K, Mg, Zn and Cu. No thresholds are known for Ca, Fe, B and Mo in cereals.
- Results from >900 YEN grain samples analysed up to last year suggest (using the 8 critical values above), that nutrient deficiencies are very common; >80% of crops showed deficiencies, and >50% showed two or more deficiencies.
- YEN Nutrition was therefore launched in 2020 to help to remedy these deficiencies – further details and registration are available here
- Crop nutrients differ in how they are shared between grain and straw at harvest. The graph below shows how a normal wheat crop stores most of its N and P in the grain but most of its K in the straw. These proportions are estimated from published tables of average feedstuff analyses.



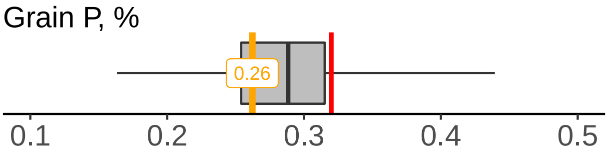


A wheat grain showing where each of the 12 essential nutrients is most concentrated.

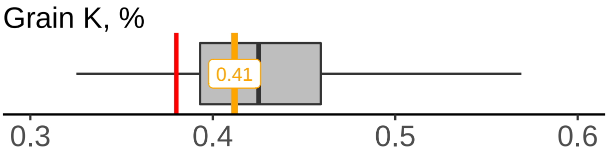
- Grain nutrients, particularly P, N, Zn and S, may usefully be taken to reflect the nutritional history of a crop through its life.
- As reliable low limits (deficiency levels) in grain are only known for N, P, S and Mn, the following benchmarking-charts provide the best means of identifying the nutrient(s) most likely to have limited your crop – compare your value with the mid-half of all the other YEN entries.
- Critical grain protein (or N% x 5.7) levels are variety-dependent so it's best to compare your value with the value reported in the AHDB Recommended List for the same variety (see page 7). If the observed protein level is significantly less or more than the RL value, we take this to indicate that this crop was under- or over-supplied with nitrogen.



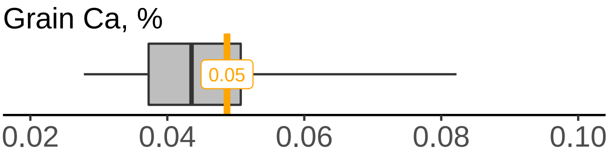
Protein (N% x 5.7) <11% indicates a likelihood of inadequate N supply for an average feed wheat. A variety's protein value given on the AHDB RL probably provides the best critical value for N (see page 7).



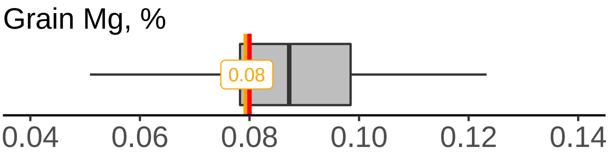
Recent research has shown grain P analysis can provide a useful check on sufficiency of phosphorus. Many values were less than 0.32% in 2020 indicating a need for further checks on P supply and capture.



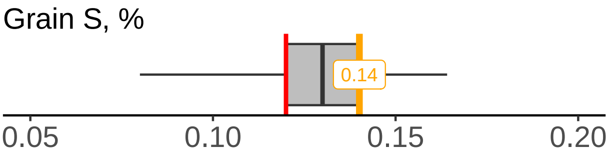
RB209 assumes a standard value of 0.54% potassium (K) in grain. Values less than 0.38% indicate a need for further checks on K nutrition, especially by soil analysis but also by analysing leaves.



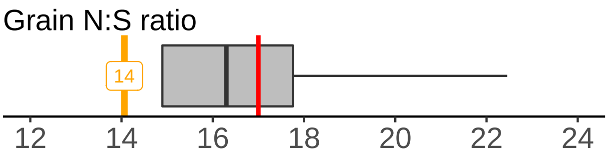
Almost all the crop's calcium (Ca) remains in the straw at harvest, so grain calcium may not be meaningful.



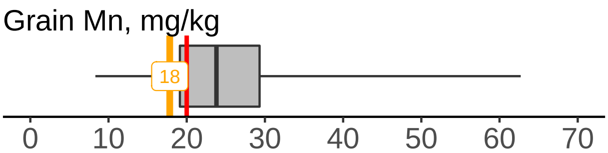
Literature shows low magnesium (Mg) values in grain are <0.08%. High grain Mg has been associated with high grain yields in YEN data from previous years.



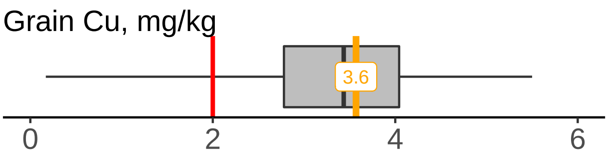
S is required in proportion to grain protein (especially glutenin) formation. Milling varieties need more sulphur than feed varieties.



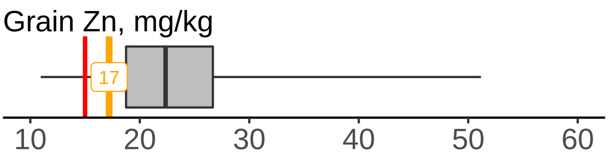
The higher the N:S ratio (greater than about 17) the more likely the crop is to have suffered from sulphur deficiency. Many samples had high N:S ratios in 2020, especially on light soils.



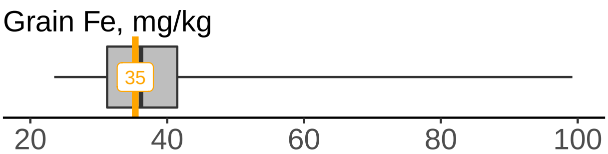
Literature shows low manganese (Mn) values in grain are <20 mg/kg. Low grain manganese was quite common in 2020.



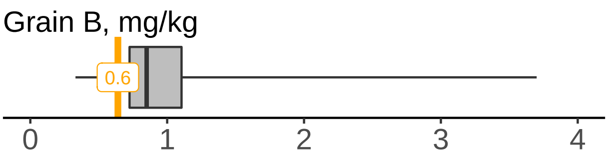
Grain copper (Cu) less than 2 mg/kg indicates possible deficiency.



Zinc (Zn) values below 15 mg/kg are considered low. Grain zinc appears to inter-relate with nitrogen availability.



We currently have no guidelines for grain iron (Fe) interpretation. Average Fe was also around 40 mg/kg in 2016, 2017 and 2018.



Most Boron is kept in the straw. Previous YEN boron values have varied hugely with season. Grain analysis may not be useful for assessing boron sufficiency.

SUMMARY

The 2019-20 competition:

- Many congratulations for providing the information necessary to complete this report; the collective efforts of all YEN contributors serve to maximise the value of what can be reported and the deductions that can be made for everyone – we call this approach 'share-to-learn', and believe that the whole industry would benefit by making this approach their normal practice.
- Given all the challenges of 2020, we are impressed by the number of participants in Cereal YEN this year; the more participants we have, the more robust and confident we can be in the comparisons we make, both at the individual 'benchmarking' level, and when analysing the whole set of data.
- The winning field yield in 2020 was 15.6 t/ha (in Lincolnshire), a remarkable achievement given great difficulties in establishing autumn-sown crops this season.
- This was the 8th year of YENs. As each YEN year passes and as more YENs develop, we are increasingly struck by the farm to farm differences; some farms are consistently achieving high yields, and several farms have achieved YEN Awards over several seasons. It is evident that a 'farm factor' is playing a big part in governing yield levels. This gives real value to being a YEN participant – through having an opportunity to compare with and learn from others.
- In terms of physiology, results over all eight years of the YEN continue to show that high yields tend to be associated with high ear numbers and high total biomass; the latter is more important than high harvest index in explaining high yields. This indicates the importance of striving for better light and water capture.
- Average UK farm yields in 2020 for each of the cereals were reduced significantly more than YEN yields:

Cereal yields in 2020	Winter wheat	Winter Barley	Spring Barley	Oats
Defra farm yield estimate, t/ha	7.2	6.6	5.7	4.8
Change from previous 5 years	-24%	-7%	0%	-15%
Median YEN yield in 2020, t/ha	10.2	9.5	7.1	5.7
Change from previous 5 years	-8%	NA	NA	NA

- Clearly crops entered in YEN were generally the best of what entrants managed to establish in the difficult autumn of 2019. Then, once established, their performance was not as seriously affected by the very wet winter and the dry spring as was feared.
- In fact, the reduced yields appear to have arisen through reduced light interception (both less incident radiation and truncated canopy survival in July). Early senescence may have been exacerbated by reduced capture of soil resources – both water and nutrients. This may partly have been through the effects of the wet winter on root development but also, summer rainfall (April-July) was on average 30 mm less than normal.
- The high harvest index was probably associated with the stem extension period starting late and being quite short so that stem growth was reduced, and crops were generally short.
- In summary, YEN studied the best crops in 2019-20 and found that their performance held up remarkably well, considering the difficult conditions in which they were established and the wet winter and dry spring weather. In relation to estimated yield potentials, performance was no worse than the average of previous seasons of YEN.

Comments on the next page are generated automatically from your data, with the aim of high-lighting features of your crop which may point out routes to yield-enhancement on your land.

SPECIFIC COMMENTS ON THIS ENTRY

Resource capture, growth and yield:

- High YEN yields have generally been associated with high biomass production. Your yield arose from a low total biomass and a very high harvest index.

- Our target for annual light interception by annual crops (whether sown in autumn or spring) is 60% compared with 31.9% achieved by this crop.

- Your grain had a length:width ratio of 1.8 and a density of 1. Such short and dense grains indicate possible sink limitation - grain storage capacity may have limited yield.

Crop Nutrition:

- Uptake of 180 kg/ha is required to build a canopy that fully intercepts light. However, beyond yield of 9 t/ha, an additional 23 kg N/ tonne is needed to form grain protein. We estimate that uptake of 195 kg/ha of N was required for your crop, compared with the 200 kg/ha taken up.

- Your grain is estimated to have had 0.26% P. Less than 0.32% indicates a need for further checks on P nutrition.

- Your grain is estimated to have had 0.08% Mg. Less than 0.08% indicates a need for further checks on Mg nutrition.

- Your grain is estimated to have had 18 mg/kg Mn. Less than 20 mg/kg indicates that manganese uptake was probably limiting.

Short review of Oilseed YEN 2019-20

Oilseed YEN saw completed entries from 38 fields in 2020. The range in gross output yields was the largest we have seen in Oilseed YEN, with a range of 1.7 t/ha to 7 t/ha. These yields reflected a challenging season for oilseed rape, with moisture and cabbage stem flea beetle (CSFB) posing problems at establishment and dry spring conditions restricting compensatory branching. Some crops demonstrated secondary flowering phases, often setting many seeds which were then poorly filled. Estimated potential yields ranged from 7.4 t/ha to 12.4 t/ha and growers on average achieved 43% of these. The winning field yield was 7.01 t/ha, and this crop demonstrates our physiological understanding of oilseed rape yields in having set many seeds and filled these well through a good supply of water and prolonged canopy life.

Update on Wheat Quality Competition

The YEN Wheat Quality Award, which is sponsored by Nabim is taking place again this year. All wheat entries which were identified in the Cereal YEN as Group 1 and which provided a large grain sample will be entered. High-quality eligible grains are now being shortlisted ready for breadmaking analysis. The winners will be announced during the virtual AHDB Milling Wheat Week to be held from Tuesday 23rd to Thursday 25th February 2021.

AHDB events

Due to ongoing restrictions following the coronavirus pandemic, AHDB have taken the decision to cancel major events up until the end of 2020. You can find information about virtual events here: https://ahdb.org.uk/events. Agronomy Week will run from Monday 30 November to Friday 4 December. It will comprise a series of webinars aimed at agronomists on important issues in contemporary agronomy. For more information, and to register, visit: https://ahdb.org.uk/agweek2020

YEN Nutrition

YEN Nutrition was initiated this year because YEN data have indicated that the majority (>80%) of crops have inadequate nutrition, one way or another. This new YEN connects anyone – farmers, advisors, suppliers and academics in the UK or abroad – seeking to improve nutrition of any grain crop – cereal, oilseed or pulse. Membership begins with grain analysis and grain nutrient benchmarking on six or more fields. Further details are available here

YEN Technical Webinars

Please join us for a series of technical webinars and register for these events if you haven't already done so:

The 2020 YEN Awards - 25th November 2020, 7pm to 8.30pm

Register here for the YEN Awards

Cereal YEN Technical Webinar - 7th December 2020, 4pm to 5.30pm

Register here for Cereal YEN Technical Webinar

Oilseed YEN Technical Webinar - 8th December 2020, 4pm to 5.30pm

Register for the Oilseed YEN Technical Webinar

YEN Webinar: how enhancement works - 10th December 2020, 4pm to 5.30pm

Register for YEN Enhancement Webinar

CONTACTS

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Or email yen@adas.co.uk for general enquiries. @adasYEN

YEN SPONSORS

The YEN was initiated by industry and is entirely industry funded. We are most grateful to all our sponsors. They not only provide funding but they are fundamentally involved in management of the YEN and in supporting individual farms in making their YEN entries. The YEN would not exist without them!

Visit www.yen.adas.co.uk for sponsors' details, news updates and to register for 2021.