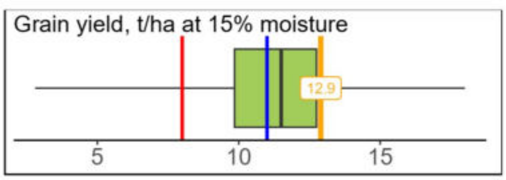
# Entrant's Report

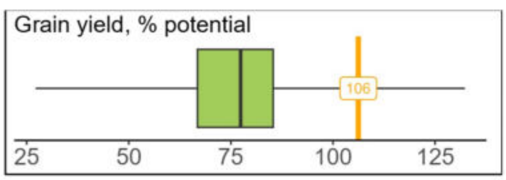
# Harvest 2022

| | |
|---|---|
| YEN User ID [redacted] | Field/Site name: [redacted] |
| Entrant name: [redacted] | Location: South East |
| Main contact email: [redacted] | Incident energy 2020-21: 42 TJ/ha |
| Sponsor/supporter: [redacted] | Available water: 273 mm |
| Sponsor/Supporter email: [redacted] | Crop: Winter Wheat |
| | Variety: Crusoe |

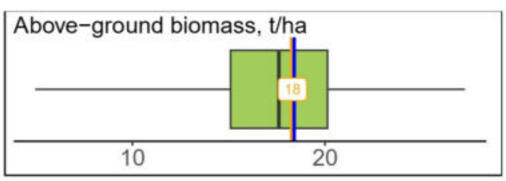
**SUMMARY:** YEN entries were completed from 252 cereal crops this year of which 52 barley or oats entries are reported separately. Headline results for your entry are shown in benchmark diagrams below. Your yield of 12.9 t/ha ranked 36th within all YEN entries. This represents 106% of its estimated yield potential of 12.2 t/ha, which ranked 7th within all YEN entries in 2022 of all 155 wheat and 20 other cereal entries.

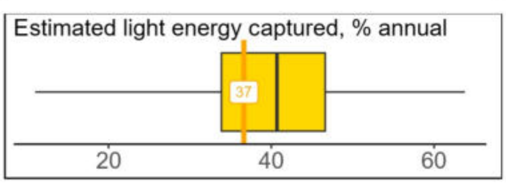


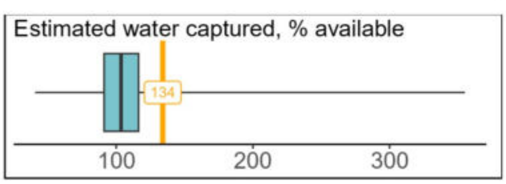

Overall yield rank: **36th**

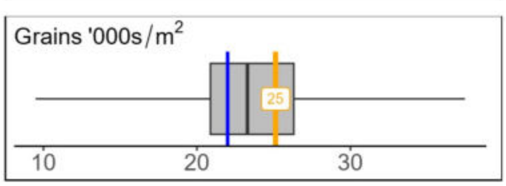


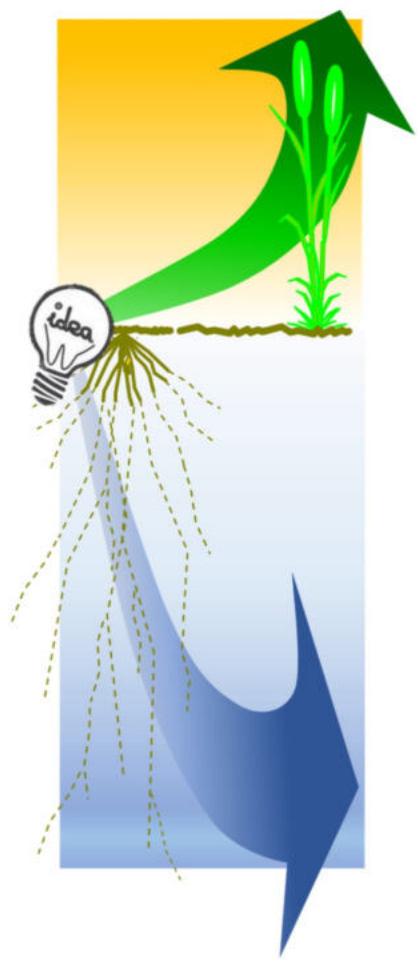

Overall potential yield rank: **7th**



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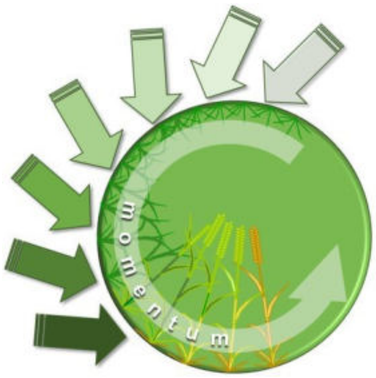
Our detailed analysis of your yield result is provided in the following pages, including comparisons with other YEN entries and with benchmarks taken from the AHDB Wheat Growth Guide and the AHDB Nutrient Management Guide (RB209), and the AHDB Recommended List. We hope that this helps you to identify 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 growing conditions and potential yields for crops grown in this season, then the conditions for and husbandry of your crop, its development, its basic resources (light energy, water & 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 storage, or better nutrition throughout growth.

To estimate potential yields, we assume a theoretically 'perfect' variety grown with 'inspired' husbandry on your land with this season's 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

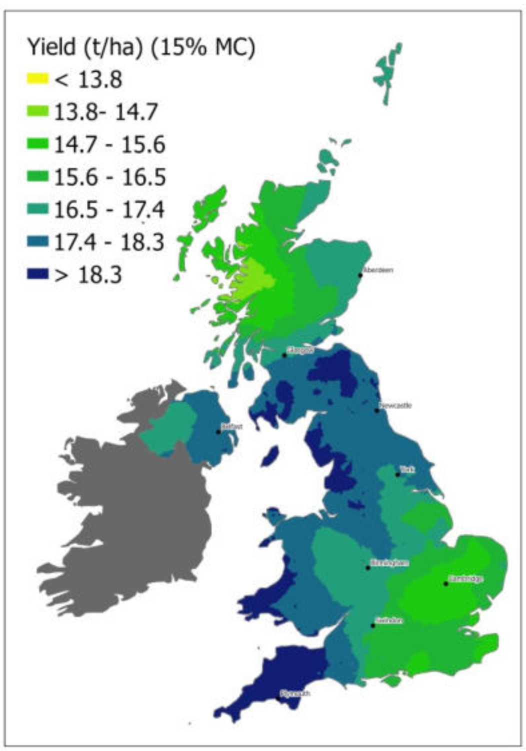
(ii) **Capture of all the available water** held in the soil to 1.5 m depth (or to rock if less) plus all rainfall from April to July, and conversion of each 18 mm into a tonne of biomass per hectare. Our model of potential yield estimates potential growth on a daily basis; this identifies impacts of water limitation more precisely than the cruder monthly estimates we made in previous YEN reports.

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.

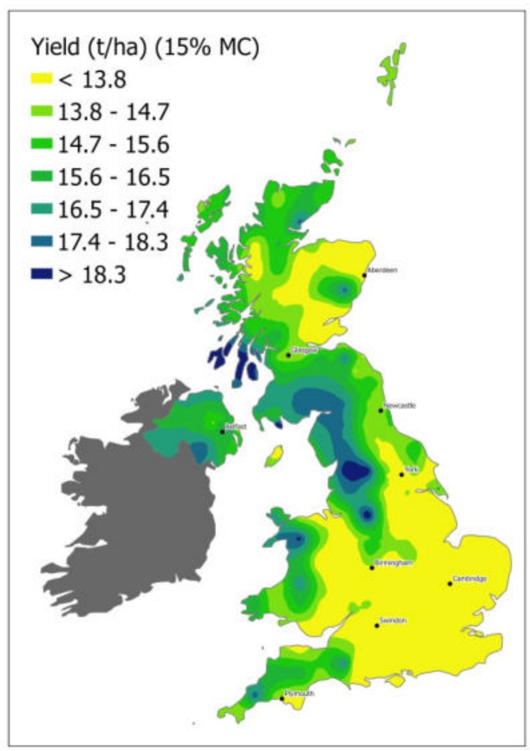
The maps below show the potential grain yields for autumn sown cereals on retentive and light soils this year. For this we assume deep soils with no irrigation. Potential yields in arable areas ranged from 12 t/ha upwards so, on most soils, high yields were theoretically possible almost everywhere.

### 2022 Potential yields

Autumn sown on retentive soil (260mm available water)




Autumn sown on light soil (160mm available water)




We are using weather data from DTN™ this year. Note we do not have long term met data from DTN so cannot show a map of long-term average yield potentials.

## In summary:

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

• Autumn 2021 allowed timely drilling; then a warm winter enabled good establishment.

• Residual herbicides were effective, but weeds emerged and grew through the winter so post emergence herbicides were needed. Groundsel was an issue.

• Slug pressure was strong, especially in the South East.

• BYDV vectors were normal in autumn. No significant BYDV was seen in summer 2022.

• The winter favoured disease progress, especially septoria, but the dry March and April reduced septoria pressure at T0 and T1 timings, and rust was controlled effectively by fungicides.

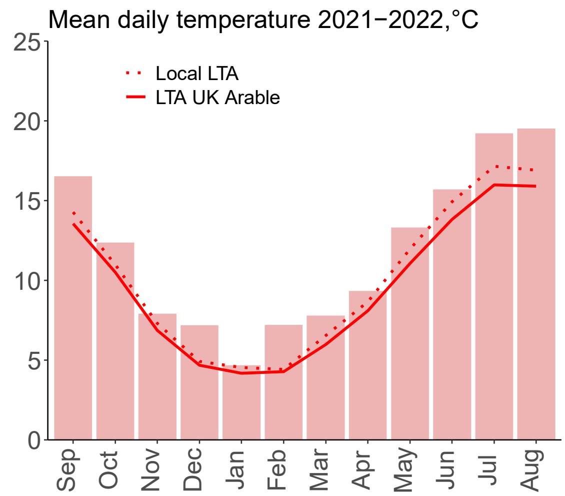
• The year was warm throughout, particularly May to July in the East so crops were advanced throughout and spray times were 7-14 days earlier than normal.

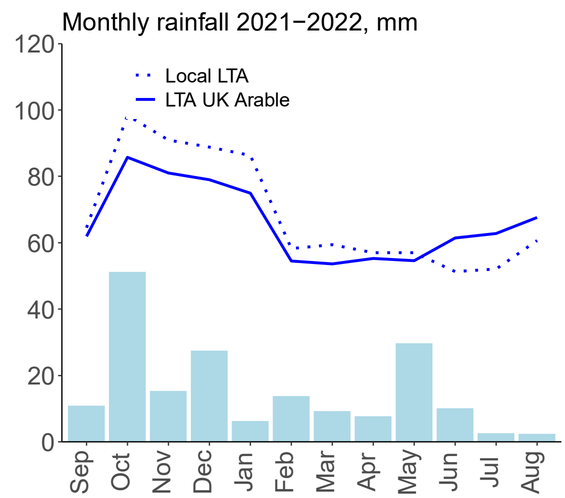
• Rains in May increased septoria pressure; the epidemic peaked in late June or early July, but was less severe than in 2021. Robust and well timed fungicide programmes provided good septoria control.

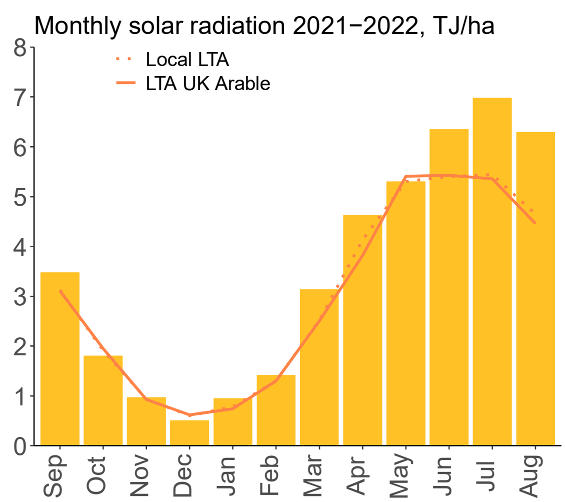
• May saw less sunshine than normal but June and July were bright and hot, so overall solar radiation for the year was 7% above the 5 year average.

• Late brown rust infections were seen in susceptible varieties. Some high ergot infections were reported, but incidence of fusarium was low. No significant summer aphids or orange wheat blossom midge were noted, although some Yorkshire crops required treatment.

• Summer was drier than in any other YEN year (since 2013) with 33% less rain normal so most crops became water-limited through June and July, particularly on light or shallow soils. This and the heatwave, with record temperatures in early July, caused early senescence of many crops and an early harvest.

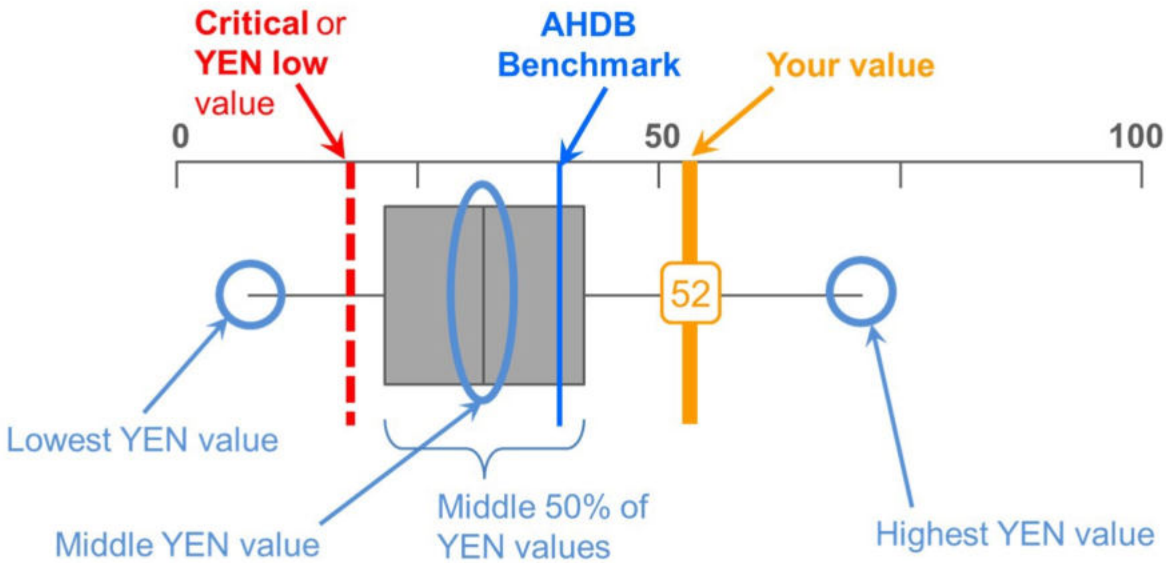


## YEN Benchmarking charts – What do they mean?

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 this year 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 2022 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 dashed lines indicate benchmark values e.g. from the AHDB's Growth Guides. Benchmark charts throughout this report summarise data provided for all YEN wheat crops (they exclude barley and oats, and any wheat data entered past the submission deadline).
Note that 'Dynamic Benchmarking' is available to all YEN members via the YEN website YEN website. This means you can compare your own yield or grain nutrient data with subsets of all other YEN crops selected by crop type, soil type, location or year back to 2013.

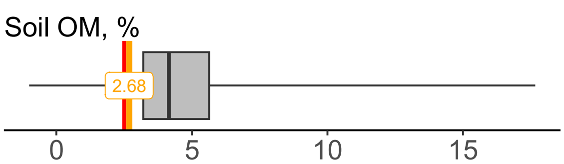
## Soil description and nutrition analysis


Your soil's capacity to hold available water is critical in determining your potential yields. We rely on entrants describing the soil where their YEN entry grew. We can use the UK Soil Observatory map viewer to check whether this complies with the surrounding land.

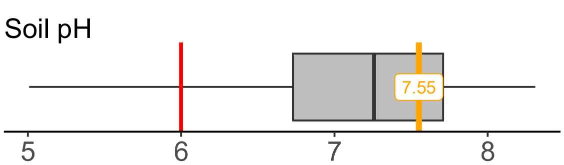
Good soil descriptions are vital in allowing us to estimate soil water holding capacity and, along with summer rainfall, the water available to your crop (see Benchmark charts in the section on 'Resources & their Capture').

Topsoil analyses provided by NRM also tell us about soil status for pH, P, K and Mg, as reported on the next page. A few sites show low values for soil pH, P, K or Mg. If these are unexpected, they may need further checks, either by repeating soil analysis and by checking both leaf and seed analyses later in this report. Previous YEN leaf and seed nutrient data have indicated that UK cereal crops often experience deficiencies in one or more nutrients, and sometimes this is despite soil levels being satisfactory. So, by combined use of soil, leaf and seed analysis, the YENs now help to diagnose whether nutrient shortfalls are arising from poor supply, or poor capture by the root system.

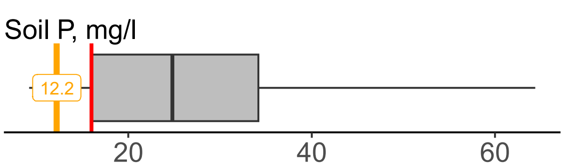
## Soil analysis



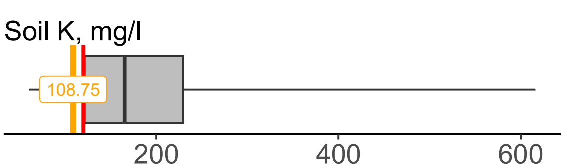

SOM supports crop performance through better nutrient availability, soil aggregation, and water holding capacity. NRM determines SOM by 'loss on ignition'. Note: other methods can give lower values.



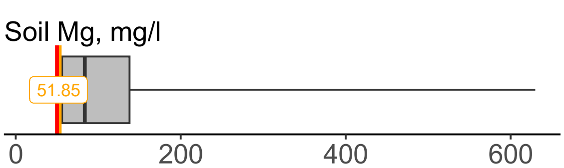

Soil pH <6 is acid. High pH soils may require that special attention is paid to phosphorus (P) and micro-nutrient levels in leaf and grain (see later).




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 double-check if P was sufficient.




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.




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

This section considers how your variety and husbandry decisions related to others entering the YEN this year. Note that the multi-year YEN dataset suggests that the individual effects on grain yield of variety choice or husbandry decision are relatively small; it is how these decisions (and other factors) are combined into the overall strategy on each farm that is responsible for the level of yield that tends to be achieved. Hence it should be possible to learn from the best performing farms. In summary, we are concluding that:

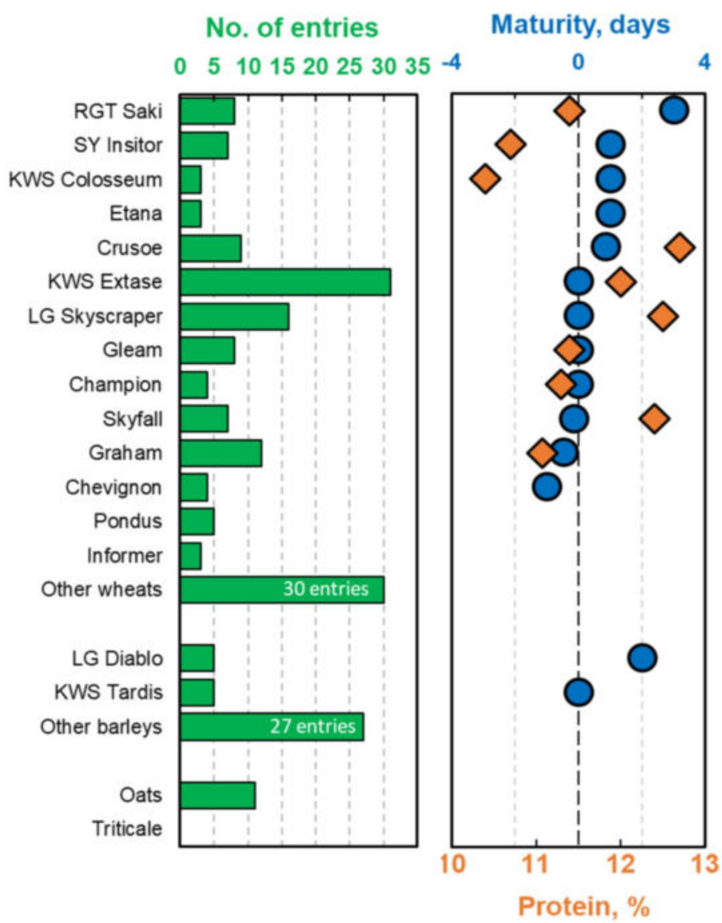
- **15 t/ha is possible almost anywhere!** High yields are not restricted to just one part of the UK.
- **Attention to detail** is important.
- **Large yields come from large crops** … i.e. taller crops with more fertile shoots
- **Best yielding seasons** had dry, bright autumns and winters, bright springs and cool summers
- **Good nutrition is hard:** most crops suffer nutrient deficiencies, especially of P.

## Variety choice

Cereal YEN entries this year included 32 different wheat varieties, 12 barleys, and 5 oats. (Note that barley and oats entries are now reported and benchmarked separately from wheat and the minor cereals.) Out of >250 entries, many entrants used varieties that are new to the YEN this year; variety choice is a key way that YEN entrants seek to drive yield enhancement.

The most chosen varieties are compared in the figure below for their maturity and grain protein levels, as reported in the AHDB's 'Recommended Lists for cereals and oilseeds' (RL). Note that the protein contents quoted here are the norms from the AHDB RL [the lower protein content; not the 'Protein content – milling spec'].

- Your variety was Crusoe, which according to the AHDB Recommended List (or alternative source for some varieties) has standard duration to maturity and has an average grain protein content of 12.7%




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'.

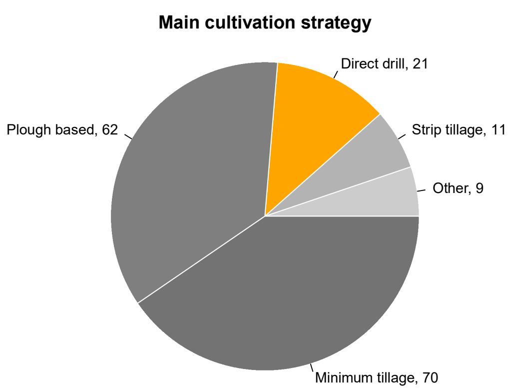
 

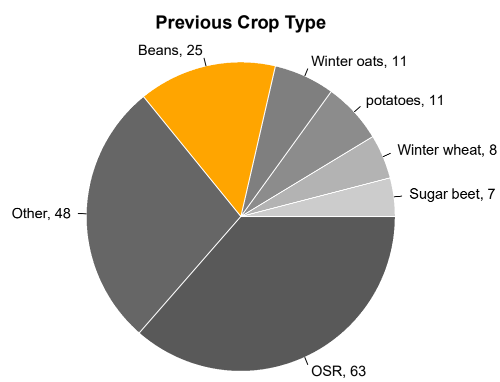
## Husbandry factors

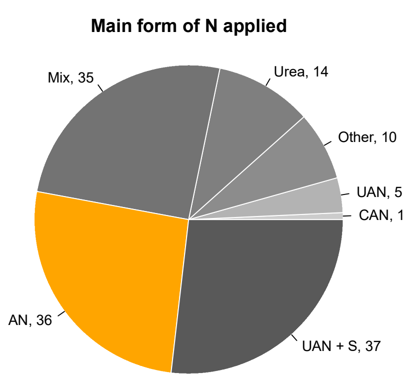
The following diagrams use orange segments or orange bars to indicate the agronomy of your crop, if known, so you can see how this relates to all other YEN entries.

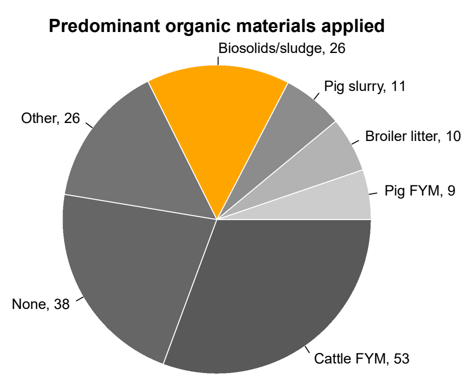
Analysis of all YEN entries since 2013 shows the following associations with grain yield (note that these do not necessarily imply causes – it may just be that farms with high yields also happen to have these traits):

| | |
|---|---|
| Soil type | better yields on more retentive soils, e.g. with more silt |
| Soil analysis | better yields with more soil P, but K & Mg not significant |
| Previous crop | better yields after OSR, veg. & forage than after sugar beet, wheat or cover crop |
| Sowing date | less grain by 0.25 t/ha per month delay |
| Seed rate | minus 0.4 t/ha per 100 more seeds / m² sown |
| Organic manure use | ~0.3 t/ha more grain if used, with poultry or digestate being best |
| N fertiliser use | 5 kg more grain per kg N (about 'break-even' in £/ha) or 0.2 t/ha more per N application |
| Forms of N fertiliser | yields don't differ between liquid or solid products |
| P, K, S, micronutrient or biostimulant use | no significant associations |
| PGR use | 0.5 t/ha more grain per PGR application |
| Seed treatment use | significant associations (but not a simple story!) |
| Fungicide use | no more grain per fungicide application |
| Insecticide or Herbicide use | no significant associations |



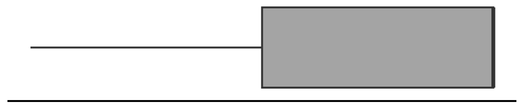



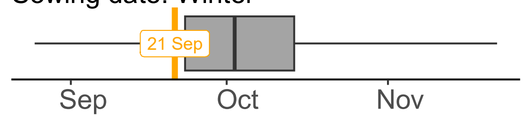



## Husbandry factors continued

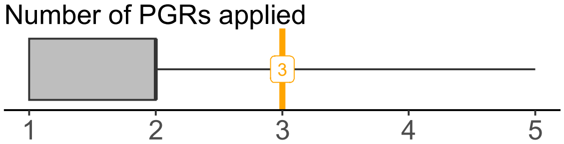
Sowing date: Spring



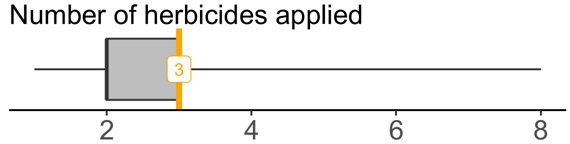
Sowing date: Winter



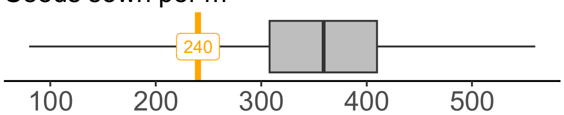

Number of PGRs applied



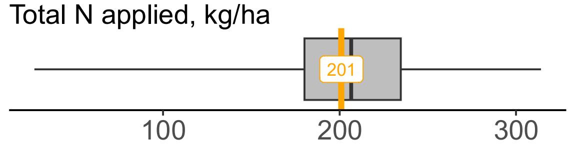

Number of herbicides applied



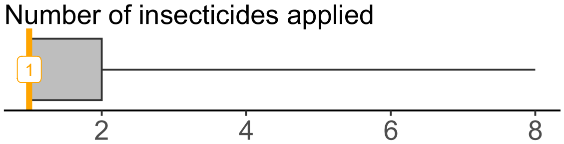

Seeds sown per $m^2$



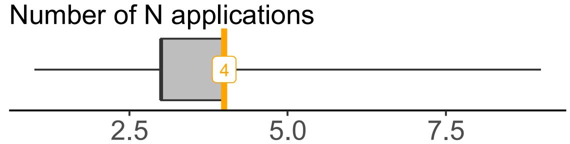

Total N applied, kg/ha



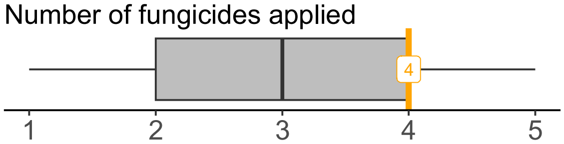

Number of insecticides applied



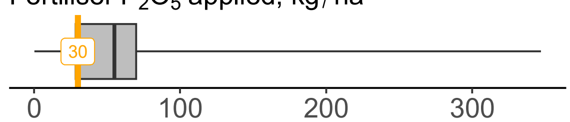

Number of N applications



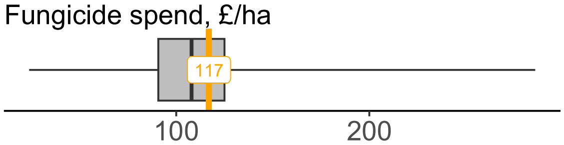

Number of fungicides applied




Fertiliser $P_2O_5$ applied, kg/ha

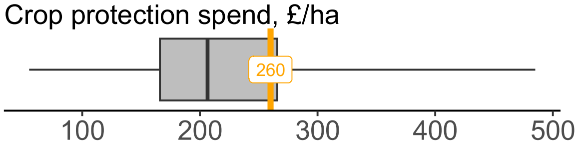



Fungicide spend, £/ha

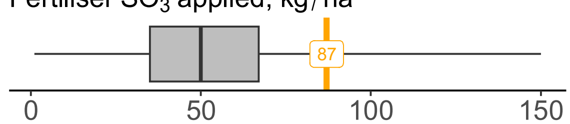



Fertiliser $K_2O$ applied, kg/ha

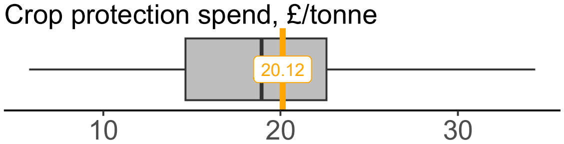

Crop protection spend, £/ha




Fertiliser $SO_3$ applied, kg/ha



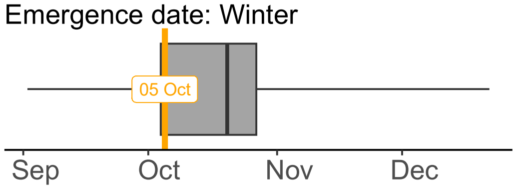

Crop protection spend, £/tonne



The following charts show how your entry developed through the 2020-21 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:

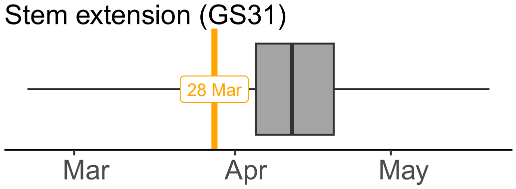
- Foundation, GS10-GS31 – when tillers and main root axes are formed,
- Construction, GS31-GS61 – when yield-forming leaves, ears and stems are formed, including soluble stem reserves
- Production, GS61-GS87 – when grains are filled, both with new assimilates and reserves redistributed from stems.

Emergence date: Winter



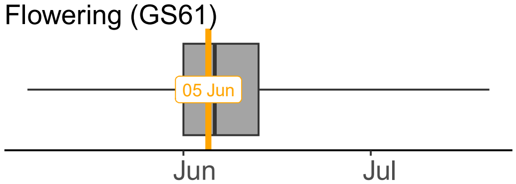

Sowing dates of winter wheats entered in YEN 2022 ranged from August to November but on average sowing and emergence dates were normal (Two entries were spring wheats).

Stem extension (GS31)



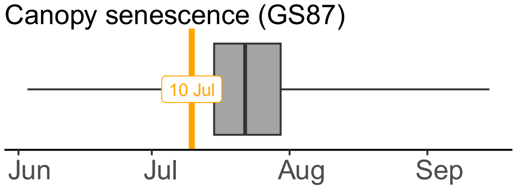

Stem extension triggers faster growth because the stem provides a new sink for assimilates.

Flowering (GS61)



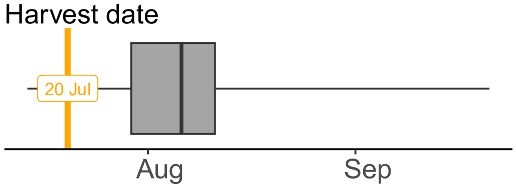

Flowering signals the start of grain formation. Delays in flowering, due say to cold weather after ear emergence, may cause growth to pause.

Canopy senescence (GS87)



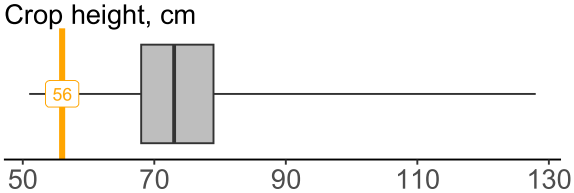

No further growth can occur after the canopy has fully senesced.

Harvest date




Harvest dates are highly susceptible to rain patterns through August & September.

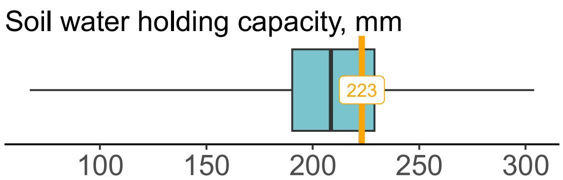
Crop height, cm



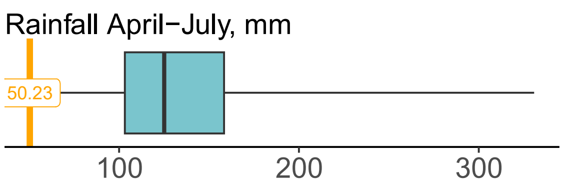

We measure height on the harvest 'grab' samples. We omit measuring samples which look to have been cut above ground level. Taller crops tend to yield better.

## Water availability and capture

This page shows how weather this year affected the water available for your crop and other crops entered in the YEN. Water is supplied through the main growing period from concurrent rainfall and also from water stored in the soil. UK soils almost always refill with water over-winter. Water potentially available to each crop through the summer includes all this soil water plus the summer rainfall (April to July).

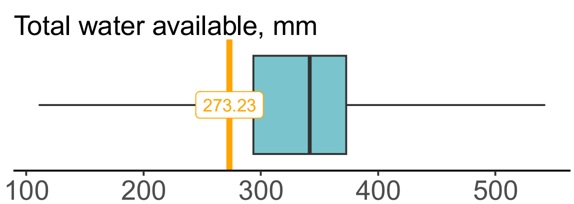



Deep soils hold water to a great depth; we assume roots can access all easily held water (to 2 bar suction) to a depth of 1.5 m (or to rock, if shallower). If enough roots didn't reach to this depth, capture of soil-available water will have been accordingly less.

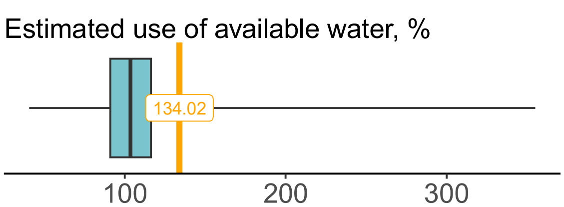



After winter drainage stops, spring and summer rainfall is held in the topsoil until it is evaporated or transpired by the crop's canopy.

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 formed), we have made crude estimates below of the likely success of your crop's root system in capturing water.




Total water is the sum of your soil's water-holding capacity and your summer rainfall (both shown above).




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.

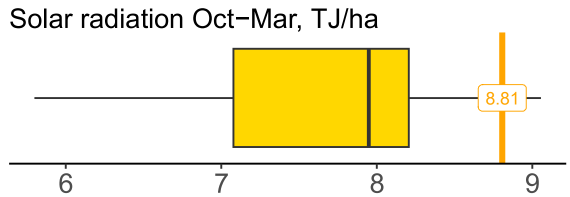
If your estimated use of available water exceeds the total water available, this may be good news! It either suggests that your crop's roots were more efficient than normal, or that your soil description was overly pessimistic: i.e. your soil apparently managed to provide more water than we estimated was possible from your soil's texture, stone content and depth.

A high yielding crop, growing say 20 t/ha of biomass (so yielding 12 t/ha grain at 15% moisture and 51% harvest index), would need to capture ~400 mm water from soil plus summer rain. Given that most of the UK's arable area often receives only 200-250 mm summer rainfall (from April to July), a large proportion of the water for high yielding crops must come from that held in the soil since the winter, mainly in the subsoil.

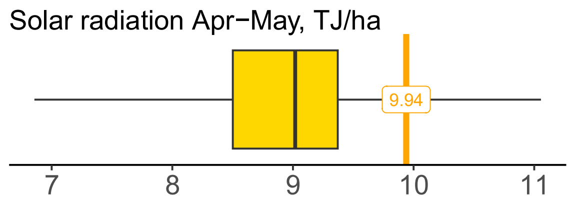
## Energy capture

The benchmarking charts below show how weather this year 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:

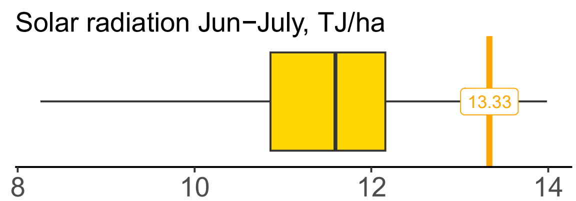
- Foundation – when tillers and main root axes are formed,




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

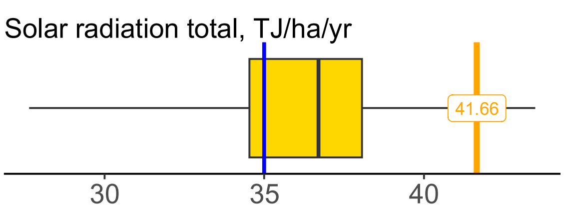



- Production – when grains are filled, both with new assimilates and reserves redistributed from stems.

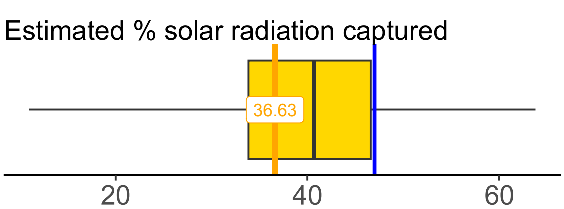



Solar radiation in September last year and August this year has been omitted, because few crops were green during those months, but crops could have achieved greater total biomass, and possibly also grain biomass, if they maintained green canopies during any part of these two months.

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 is generally less in the north and more in the south.

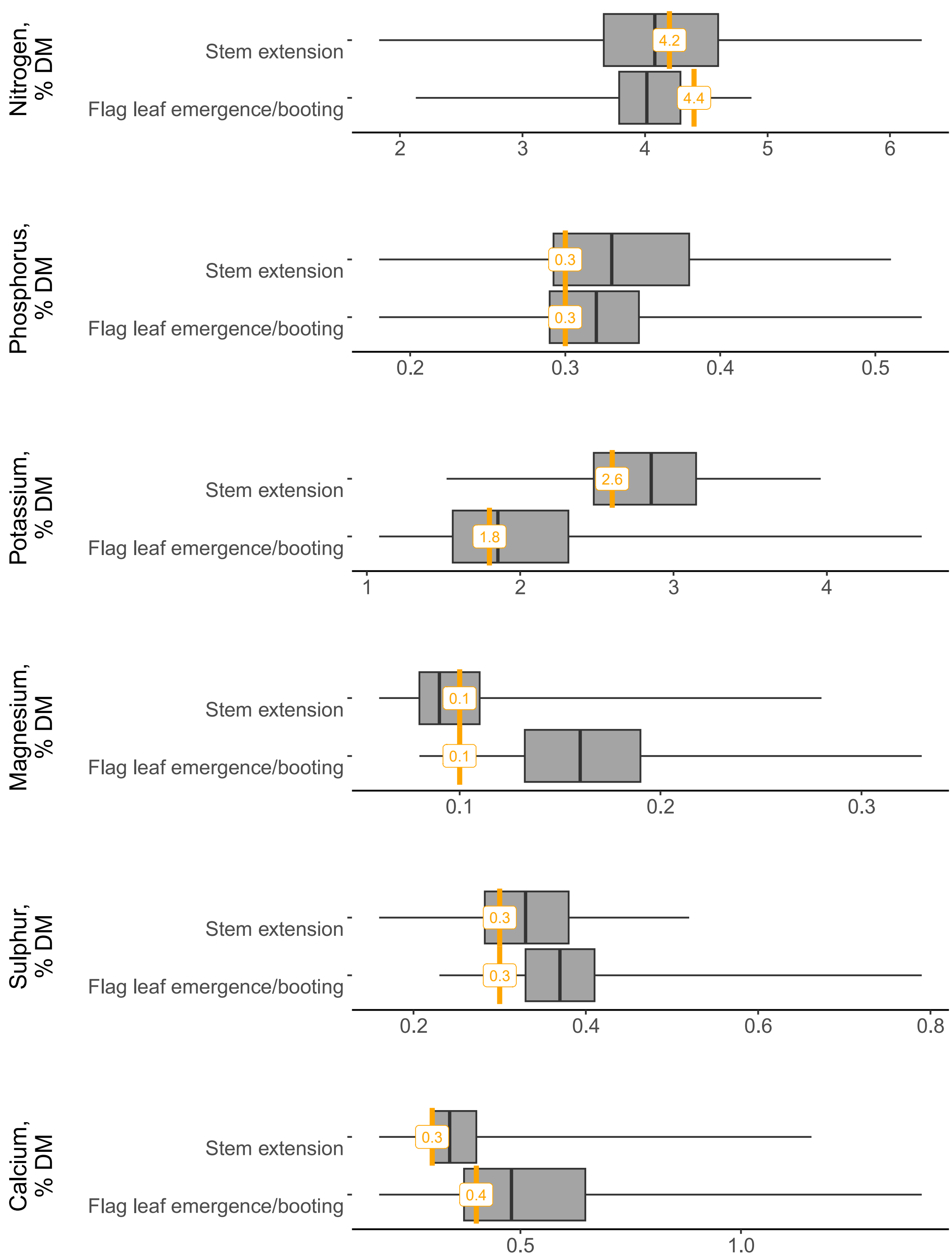


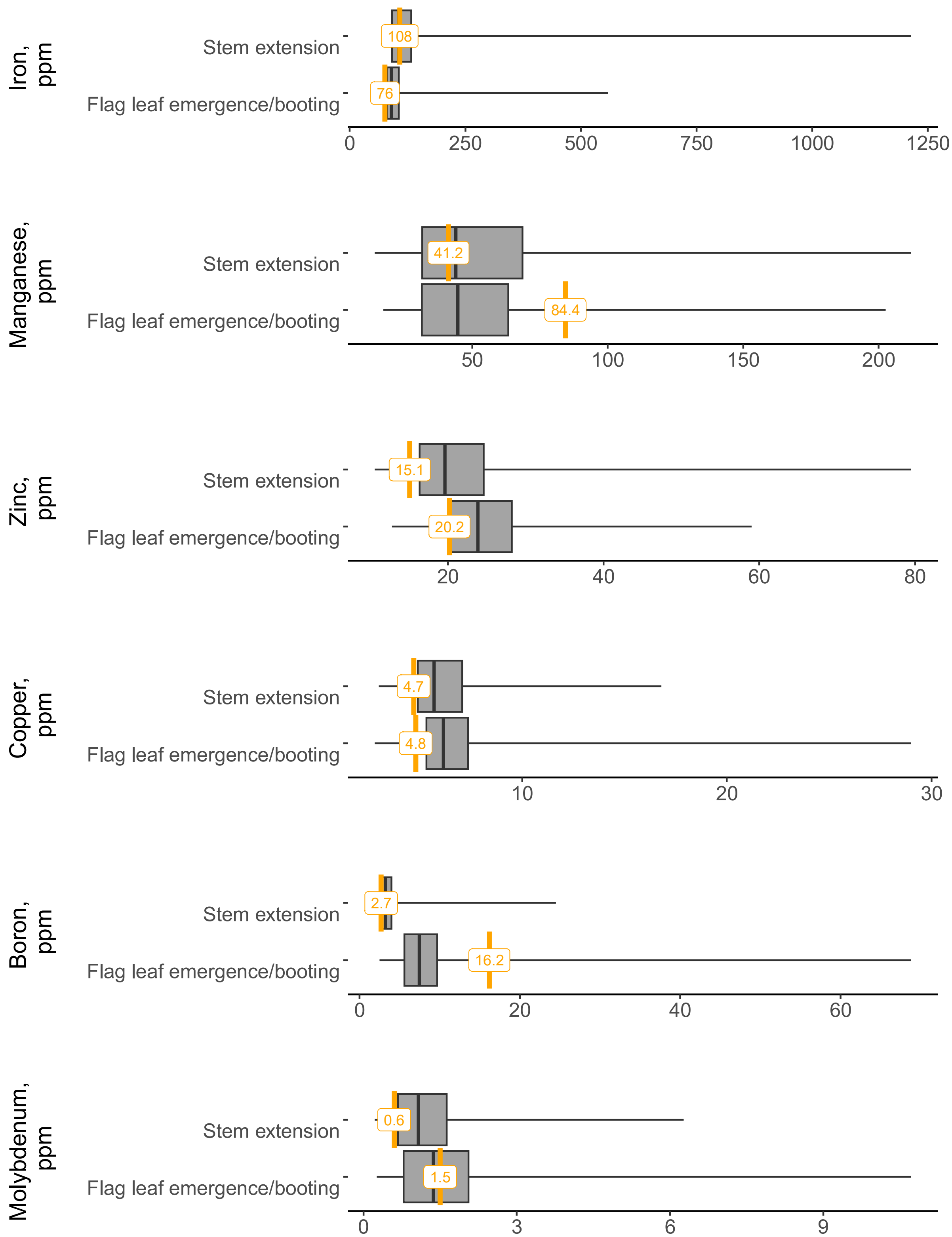

Average light capture tends to be poor if a crop's lifespan is short. The benchmark wheat crop yielding 11 t/ha intercepts 47% of annual solar radiation.

## 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 two 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 this year, analysed at the same time.

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

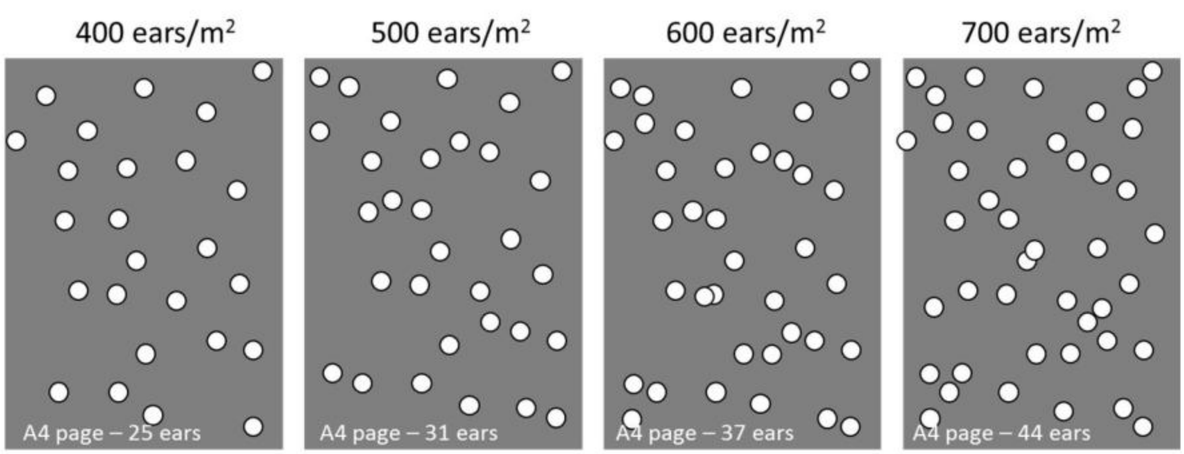



Iron, ppm
Stem extension
Flag leaf emergence/booting
108
76
0
250
500
750
1000
1250
Manganese, ppm
Stem extension
Flag leaf emergence/booting
41.2
84.4
50
100
150
200
Zinc, ppm
Stem extension
Flag leaf emergence/booting
15.1
20.2
20
40
60
80
Copper, ppm
Stem extension
Flag leaf emergence/booting
4.7
4.8
10
20
30
Boron, ppm
Stem extension
Flag leaf emergence/booting
2.7
16.2
0
20
40
60
Molybdenum, ppm
Stem extension
Flag leaf emergence/booting
0.6
1.5
0
3
6
9

## 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:

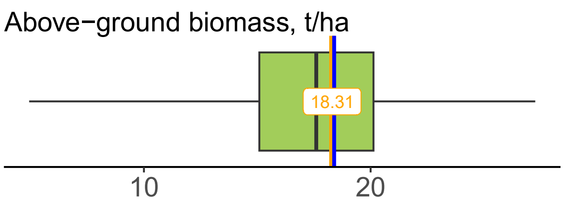


## Yield formation

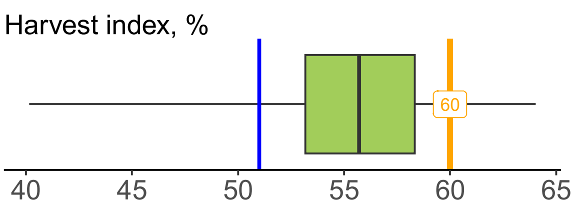
The whole-crop samples that YEN entrants provide all have their components counted and weighed and results are shown in the following charts, assuming that each sample was representative of the whole area from which grain yield was determined. [All area-related values are derived from the validated grain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

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.

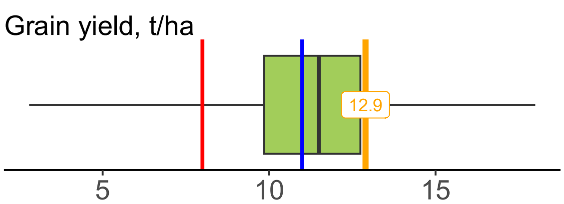
Your grain yield (expressed as t/ha and % of potential) is shown below along with biomass and harvest index, in relation to all other YEN entries and to the AHDB Benchmark grain yield of 11.0 t/ha.



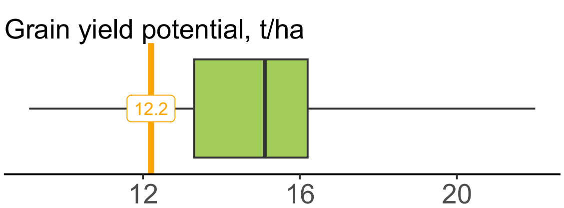

YEN experience has been that high biomass relates to high yields.



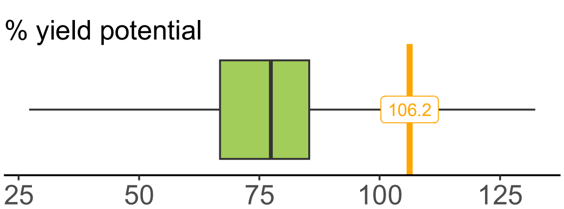

Harvest index is the percentage of total biomass that was harvestable as grain. Years with high fertile shoots tend to have low harvest index.




Yields of less than 8 t/ha can often be unprofitable, depending on prevailing grain prices.



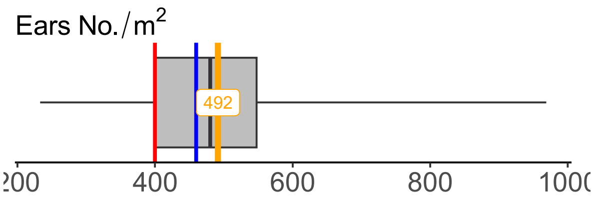

YEN yield potential reflects light energy and water available at your site this year, expressed in t/ha.



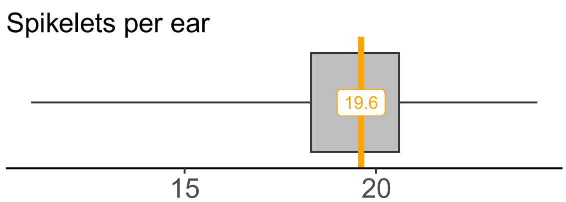

Any YEN entry exceeding 100% of its estimated potential must have found more light or water than was estimated at this site, or must have grown with exceptional efficiency.

## Yield components

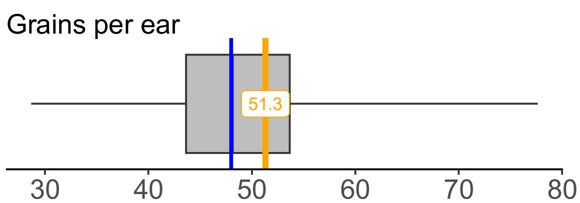
Grab sample analysis tells the story of your crop because the different yield components are determined sequentially, first shoots, then ears, then grains per ear, then grain weight. Comparing your yield components with those of other YEN entrants should indicate the stage(s) through the season at which your crop deviated from others and from normal (represented by the AHDB Benchmarks, blue lines).



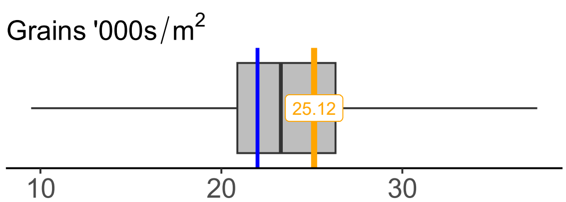

Ears per $m^2$ depend on plant establishment, then tillering, and then the survival of each shoot during stem extension.



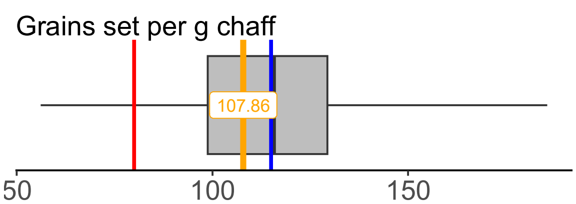

Spikelet numbers are determined between GS30 (ear at 1cm) and GS31 (1st node). Numbers are crucial for barley but not for wheat because wheat is flexible in the number of grains it sets per spikelet.




Grains per ear can be less than normal either through compensation for high ear numbers or if May was dull.




High yields almost always depend on grain numbers per $m^2$ being high (>25,000/$m^2$) through combining good ear numbers with adequate grains per ear (above).



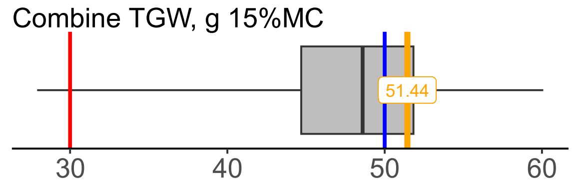

High grains/g chaff indicates that conditions around flowering time were good for photosynthesis. Less than 80/g is poor.

## Grain formation and size

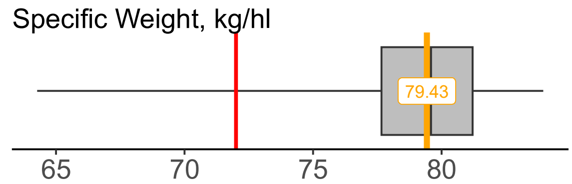
We use your combine-harvested grain sample to provide the analysis of grain size and grain filling on the next page. Grain filling depends mainly on photosynthesis after flowering, therefore it largely relies on the health and longevity of the green canopy, but sugars stored in the stem can also provide 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 (giving a so-called 'Brix reading'). Stem storage of sugars depends on shoot numbers and sunshine levels in May being good.

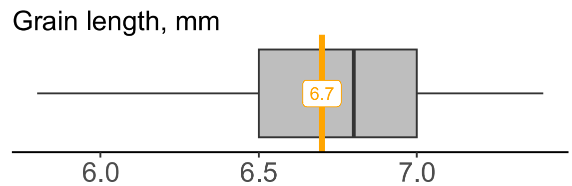
If grain number per $m^2$ is low (see above), or if conditions during early grain-fill are limiting, final grain filling, hence yield, may be constrained even if later conditions are good – this is sometimes described as 'sink' limitation. We try to use analysis of grain volume and grain density to deduce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



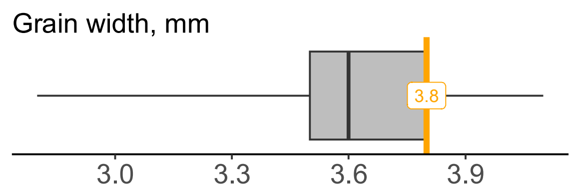

Thousand grain weights (TGW) depend on early grain expansion to set up the potential grain size and then on continuing supplies of photosynthates to replace grain water with starch.



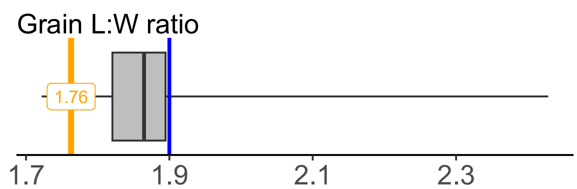

Specific weight is used as a quick indicator of flour extraction and shows weights of bulk grain for storage & transport.



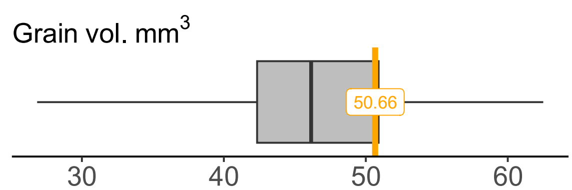

Grain length is set before grain width and tends to indicate potential grain storage capacity.



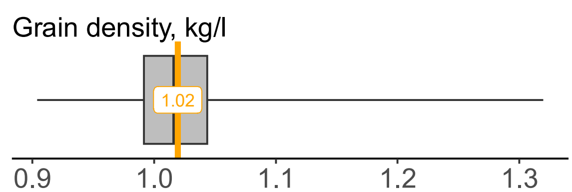

Grain width reflects the success with which grain storage capacity is filled.



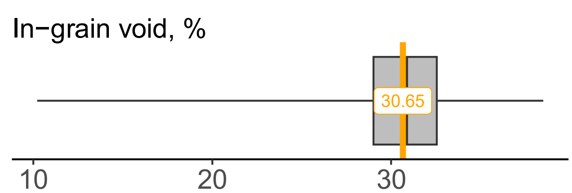

A high grain L:W ratio indicates that assimilate supply for grain filling did not fully satisfy the grains' potential storage capacity.



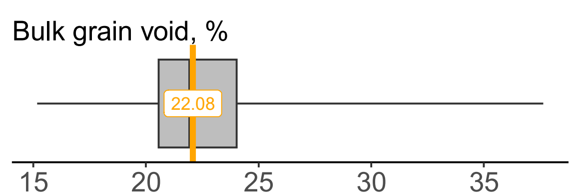

Grain volume here is the product of length and cross-sectional area, assuming grains are ovoid, so this volume includes the grain's 'crease'.




Low density grains indicate that grain filling was not constrained by storage capacity (volume) – so they were not 'sink limited'.




The density of starch, the main grain constituent, is 1.5, so it is possible to estimate the proportion of grain volume, including the crease, that was unfilled. Most years have averaged 33% in-grain void.

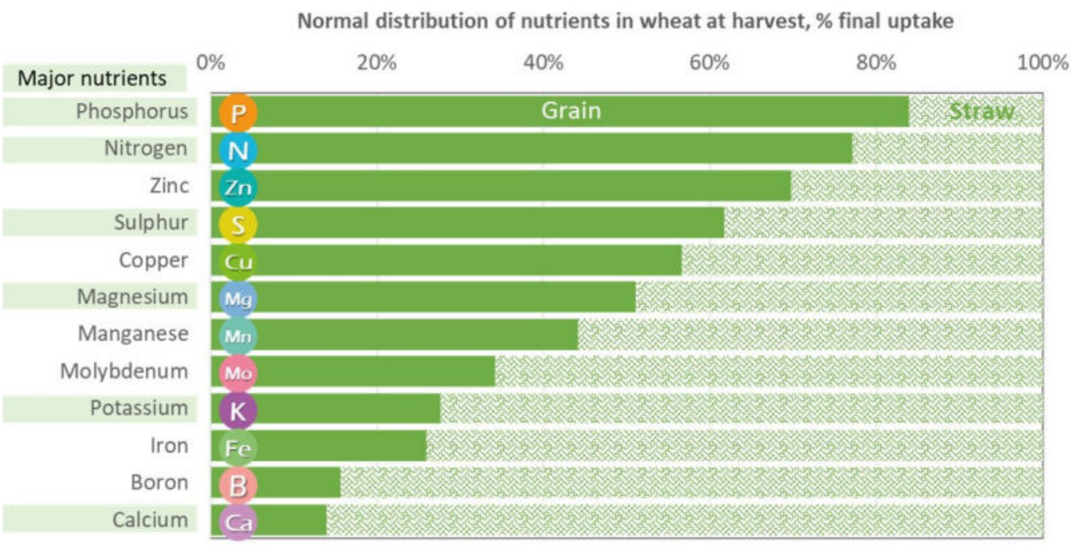


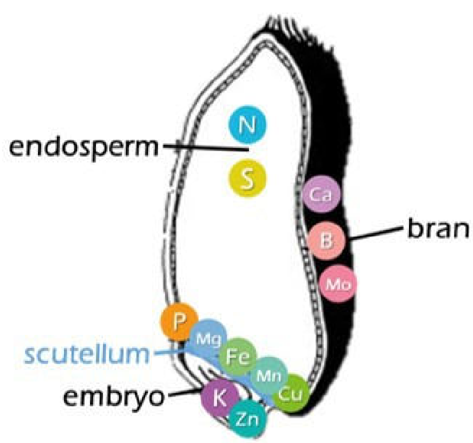

Did you know more than half of a load of grain is air?! High specific weight is achieved by having both dense grains and small voids between grains (under standard packing conditions). Bulk void is affected by grain shape and packing.

# CROP NUTRITION POST-MORTEM

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

- Results from >2,000 YEN cereal samples analysed up to last year suggest that nutrient deficiencies are very common (using the 8 critical values that we know so far); >80% of crops showed deficiencies, and >50% showed two or more deficiencies! Phosphorus (P) deficiency has been most common.
- 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 different crop species store most of their N & P in the grain but most of their K in the straw (as estimated from analyses of feed materials).

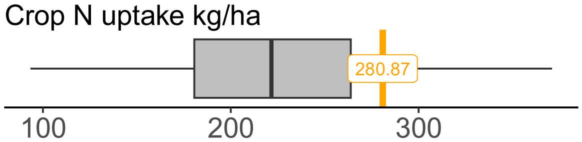


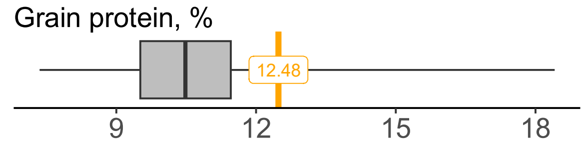

A wheat grain showing where each of the 12 essential nutrients is most concentrated.

- We now use YEN-low values (i.e. lower quartiles from all past YEN data – the boundary between the bottom quarter and top three-quarters of all YEN values since 2013) as comparators (red lines) for all nutrients in all crops. We find YEN-low values to be very similar to known critical thresholds of N, P, S and Mn in wheat, as well as to less certain critical values of K, Mg, Cu & Zn, so we assume they can be applied for all nutrients in all crops.
- The following benchmarking-charts and YEN-low values provide the best means of identifying the nutrient(s) most likely to have limited your crop.
- 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 that 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.

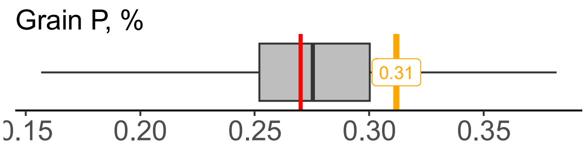
Crop N uptake kg/ha



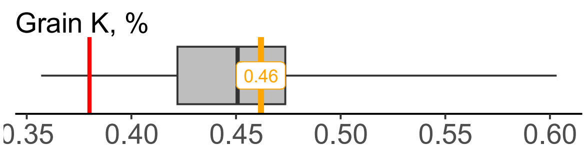

Total crop N uptake can be useful in judging the efficiency of your N management. NB: a typical wheat crop captures ~60 kg/ha N from the soil plus 60% of its fertiliser N.



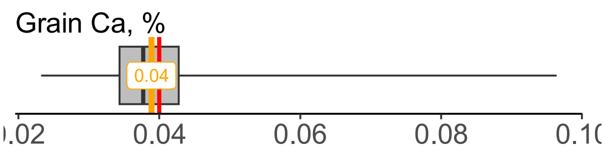

Protein (N% x 5.7) <11% indicates a likelihood of inadequate N supply for an average feed wheat. A variety's protein value given on the AHDB RL probably provides the best critical value for N (see page 7).



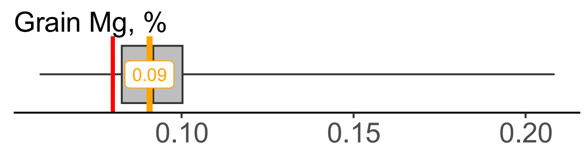

Recent research has shown grain P analysis can provide a useful check on sufficiency of phosphorus. Many past YEN values have been less than 0.32% indicating the difficulty of ensuring good P supply and capture.



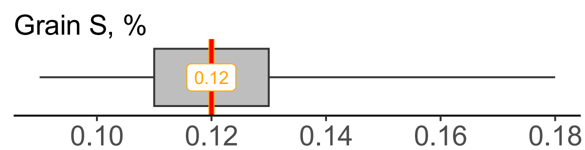

RB209 assumes a standard value of 0.54% potassium (K) in grain. Values less than 0.38% indicate a need for further checks on K nutrition, especially by soil analysis but also by analysing leaves.



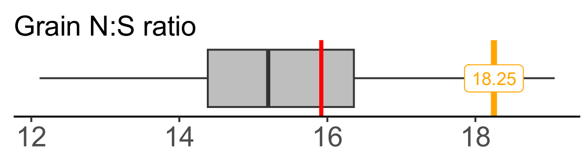

Calcium nutrition relates to the crop's use of water. However, almost all the crop's calcium remains in the straw at harvest, so we are yet to learn whether grain calcium can tell us about the crop's water status.



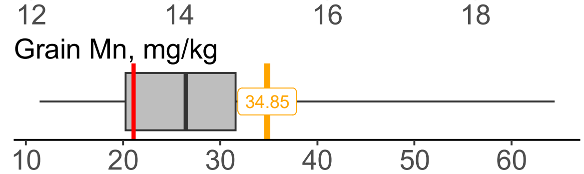

Literature shows low magnesium (Mg) values in grain are <0.08%. YEN data from previous years show high grain Mg has been associated with high grain yields.



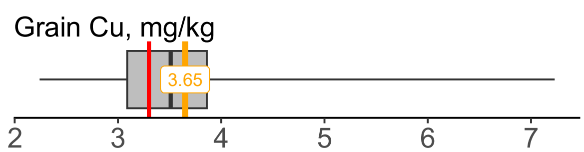

S is required in proportion to grain protein formation (especially for gluten). Milling varieties need more sulphur than feed varieties.



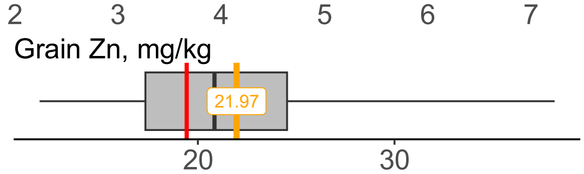

A high N:S ratio (greater than about 17) indicates the crop was affected by sulphur deficiency.



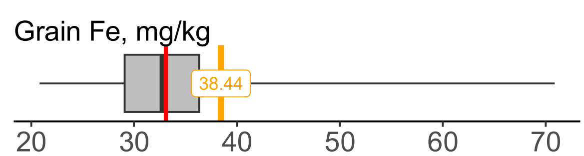

Literature shows low manganese (Mn) values in grain are <20 mg/kg. If crops show low grain manganese, leaf Mn should be checked – see Page 13.



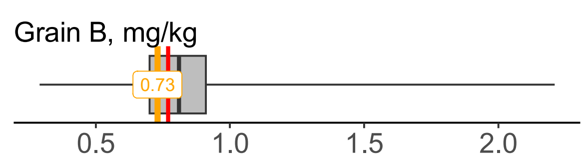

Grain copper (Cu) less than 3 mg/kg may be too low. Very few YEN samples have been this low.




Zinc (Zn) deficiency has been rare in YEN crops. Values below 15 mg/kg are considered deficient. Grain zinc appears to inter-relate with nitrogen availability.




We currently have no guidelines for grain iron (Fe) interpretation. Average Fe has been around 40 mg/kg in previous years of YEN.



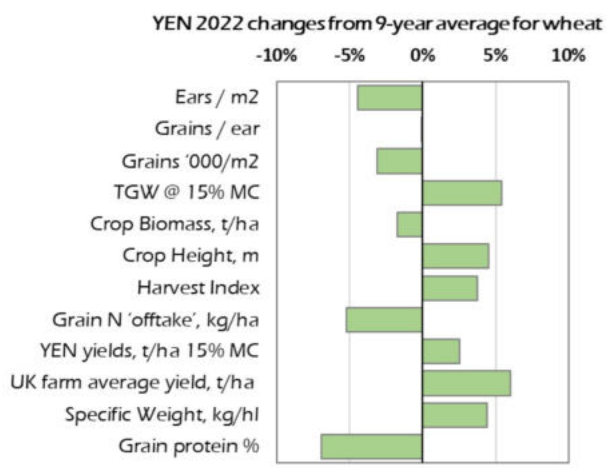

Most Boron is kept in the straw at harvest. Previous YEN boron values have varied hugely with season, so grain analysis may not be useful for assessing boron sufficiency.

## The 2021-22 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 'learning by sharing' and believe that the whole industry would benefit by making this approach their normal practice.
- The number of participants in Cereal YEN this year was more than last year, and similarly diverse, so we have been able to report and rank barley and oats entries separately. Crops were from all over the UK, and from across Europe including the Netherlands and Denmark. All these data are invaluable; the more data we have, the more robust and confident we can be in the comparisons we make, both when 'benchmarking' and when analysing associations within the whole set of data.
- This was the 10th year of YENs. The winning field yield in 2022 was a new YEN record of 18.0 t/ha (in Lincolnshire). 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 who consistently perform very well.
- Estimated UK farm average yields in 2022 were 7-9% better than the 5-year average for each of the cereals, but only wheat (and possibly oats – we only have data since 2020) showed better YEN yields this year. YEN yields far exceeded farm averages:

| Cereal yields in 2022 | Winter wheat | Winter Barley | Spring Barley | Oats |
|---|---|---|---|---|
| Defra farm yield estimate, t/ha | 8.59 | 7.42 | 6.22 | 5.79 |
| Change from previous 5 years | +8% | +7% | +9% | +8% |
| Average YEN yield in 2022, t/ha | 11.31 | 9.20 | 7.38 | 6.95 |
| Change from previous 5 years | +6% | -1% | -3% | (+8%) |

- In terms of physiology, although ear numbers were a little low in 2022, over all ten years of the YEN high yields associate with high ear numbers and high total biomass; the latter is more important than harvest index in explaining yields. Hence the importance of striving for good light and water capture.
- In 2022, after good crop establishment and tillering, the dry spring restricted N uptake so shoot survival was reduced. Then a dull May did not allow floret survival to compensate, so grain numbers were less than the YEN averages. However, flowering and grain filling were about a fortnight ahead of normal and wheat crops were surprisingly successful in capturing soil-stored water. Hence, grain filling largely escaped the worst of the hot, dry July and more than compensated for the reduced grain numbers. Thus, YEN yields were slightly better than the long term average.
- In summary, wheat yields in 2022 were good: the 3rd highest of all ten YEN years so far. Overall, 5% crops exceeded 15 t/ha and included a potential world record of 18 t/ha. Because of their generally widespread moisture limitation yields showed many growers just how much water their soils and rooting systems can provide. This should be very useful in building yield enhancing strategies into the future.




Comments on the next page are generated automatically from your data, with the aim of highlighting 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 normal 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 36.6% 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:

- Grain protein content of this crop was low for Crusoe, indicating a likely inadequate N supply

- 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 270 kg/ha of N was required for your crop, compared with the 281 kg/ha taken up.

- Your soil P was 12 mg/l. Levels below 18 mg/l can indicate deficiency: check your grain P to see if P was sufficient.

- Your grain is estimated to have had 0.31%P. Less than 0.32% indicates a need for further checks on P nutrition.

- Your soil K was 109 mg/l. Levels below 120 mg/l can indicate deficiency.

- Your grain is estimated to have had an N:S ratio of 18. Ratios greater than 17 indicate that the crop probably suffered from sulphur deficiency.

## Review of Oilseed YEN

Out of 45 entries in 2022 gross output of oilseed rape crops ranged from 3.4 t/ha to 8.9 t/ha, with the winning crop located in Lincolnshire achieving an impressive 8t/ha yield along with an oil content of 48.5%. On average crops achieved 61% of potential yield which ranged from 7.0 t/ha to 12.5 t/ha. Crops generally established well, with adequate moisture minimising CSFB damage. Dry conditions in spring would have restricted canopies becoming too large, although conditions may have hampered N uptake in some crops. Sunny April conditions along with rainfall in May were conducive for setting high seed numbers. The majority of seed filling took place in June which was sunnier and only slightly warmer than average - giving a high rate of photosynthesis helping seed filling and oil formation. Oilseed YEN also included 10 Linseed entries this year – it has been great to see the number of entries increase and develop our understanding of linseed physiology and yield potential.

## Wheat Quality Competition

The YEN Wheat Quality Award, sponsored by UK Flour Millers, is taking place again in 2022. All Group 1 wheat entries which provided a large grain sample have been entered and the best are being short-listed. Following breadmaking analysis and assessment, the winners will be announced during the Awards Dinner evening on Tuesday 24th January 2023 (see below).

## AHDB events

Several AHDB Monitor Farms entered the YEN competition for 2022 and YEN will be included in a number of upcoming monitor farm meetings, please visit the AHDB website for more details.

## YEN Nutrition

YEN Nutrition was initiated in 2020 because YEN data had 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 Zero

With the industry targeting net zero emissions by 2040, YEN Zero was initiated in 2021 with the overarching aim of creating a community of farmers and key players from across the agricultural industry to compare field-scale carbon footprints across farms, and build understanding of the issues and opportunities for making progress. Further details are available here.

## 'YEN is ten' Conference and Awards dinner

If you haven't done so already, please register and come to the YEN's tenth birthday conference at East of England Arena, Peterborough on 24th January 2023. You can Register for the YEN Conference here.

## CONTACTS

Please send any comments, observations or queries to the contacts below.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## 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 2022.

 